JUL 24 1922

Devoted to Civil Engineering and Contracting

Engineering News-Record

July 20, 1922

Articles on Six Important Fields of Engineering

Roads

Top Soil Road Theory and Practice
in North Carolina

Railroads

Concrete Unit Round Houses on the
Pennsylvania R. R.

Construction

Building the Core Wall of the Wanaque Dam in a Narrow Trench
By A. H. Pratt

Irrigation

Return Flow Water From Irrigation Development
By Ralph I. Meeker

Municipal

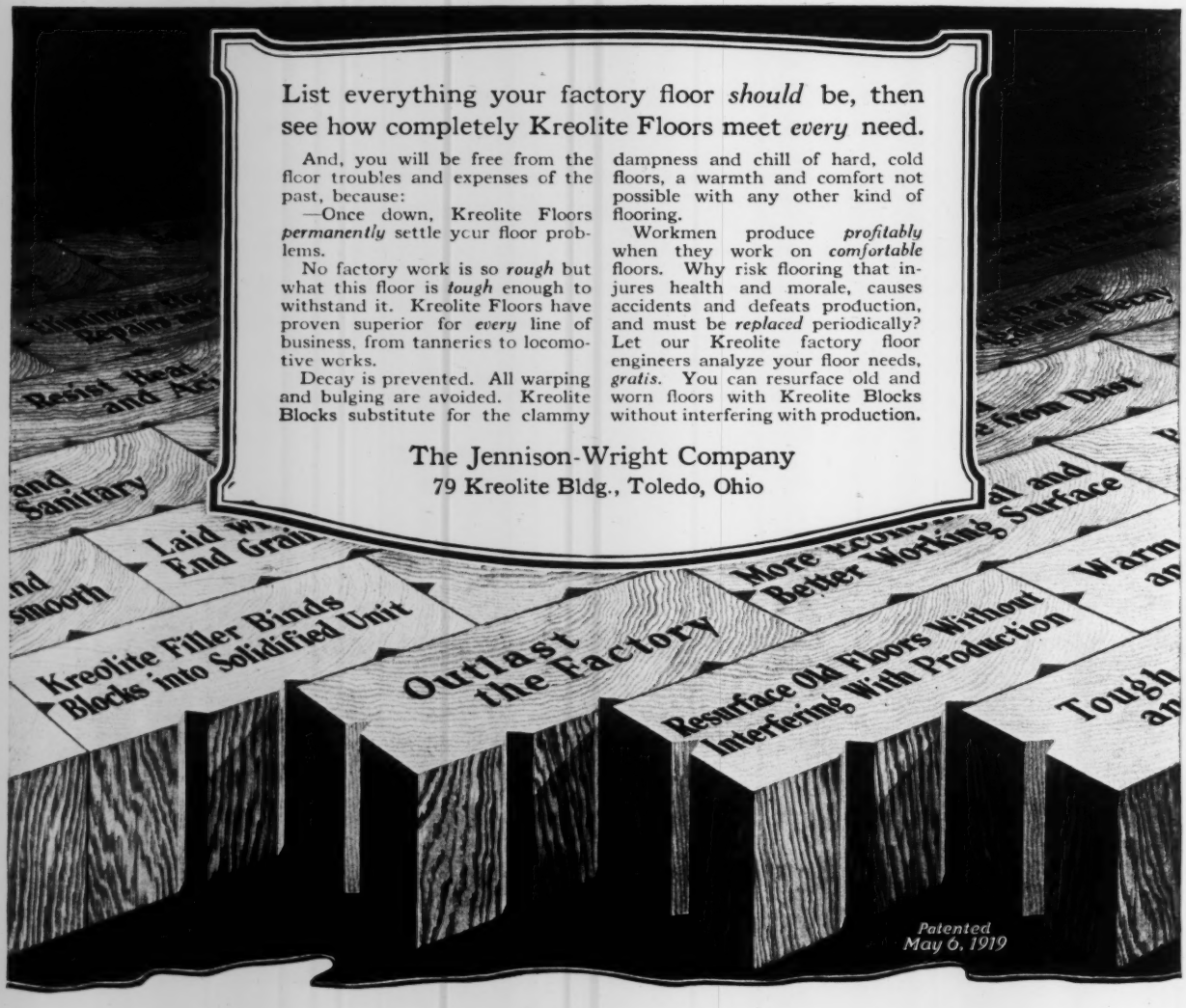
Geodetic Control and Its Relation to City Engineering and Surveying
By Hugh C. Mitchell

Industrial

How to Make Plant Inventories
By F. W. Wilson

McGraw-Hill Company, Inc.

KREOLITE


Kreolite Filler Binds Blocks into Solidified Unit
Outlast the Factory
Resurface Old Floors Without Interfering With Production
Patented May 6, 1919

List everything your factory floor *should* be, then see how completely Kreolite Floors meet *every* need.

And, you will be free from the floor troubles and expenses of the past, because:

—Once down, Kreolite Floors *permanently* settle your floor problems.

No factory work is so *rough* but what this floor is *tough* enough to withstand it. Kreolite Floors have proven superior for *every* line of business, from tanneries to locomotive works.

Decay is prevented. All warping and bulging are avoided. Kreolite Blocks substitute for the clammy dampness and chill of hard, cold floors, a warmth and comfort not possible with any other kind of flooring.

Workmen produce *profitably* when they work on *comfortable* floors. Why risk flooring that injures health and morale, causes accidents and defeats production, and must be *replaced* periodically? Let our Kreolite factory floor engineers analyze your floor needs, *gratis*. You can resurface old and worn floors with Kreolite Blocks without interfering with production.

The Jennison-Wright Company
79 Kreolite Bldg., Toledo, Ohio

FLOORS

WOOD BLOCK

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 89 — NEW YORK, JULY 20, 1922 — Number 3

Water Power Not Fertilizer

EVIDENTLY the Senate is not to be stampeded into giving Muscle Shoals to Henry Ford. By a close, and almost strictly sectional, vote the committee has decided not to recommend the acceptance of the Ford, or any other offer. The case now goes to the entire Senate with a fair chance that it will there be debated on its merits as a water-power proposition and not decided as a fertilizer development. There will be the usual attempt to brand all opposition to Ford as the creation of the fertilizer trust but the unfair and invidious bestowal of water-power which Ford requests has been brought out clear of the fertilizer smoke screen, so that senators will at least vote with their eyes open.

Precision in City Surveying

THOUGH aphorisms are usually poor tools with which to quicken human action or interest, in reading Mr. Mitchell's article elsewhere in this issue on the value of geodetic control in city surveying one is struck with the idea that what is worth doing must be worth doing well. The accuracy of city-survey work too often is in direct proportion to the front-foot value of the city property. That means that small and perhaps inconspicuous municipalities are not very careful in establishing control stations, leaving more accurate methods to later generations. Each city engineer, however, should remember that his municipality is a potential metropolis. Use of precise methods of control for plane and topographic surveying will cost little more than slip-shod methods. From the questionnaire mentioned in the article it appears that degrees of accuracy now used are about as numerous as the cities circularized. Mr. Mitchell's plea that the first survey should be accurate and permanent ought to make city engineers see the responsibility of their jobs from a new angle.

Turning Back the Clock

BOTH railroad strike and coal strike have now carried far beyond the issues on which they were ostensibly called. The shopmen, with aid and comfort from other railroad workers, seem bent on putting the Labor Board out of business. They would rather fight with the railroads than negotiate with the Board. Mr. Jewell, their leader, gloats over the difficulties of the roads and declares that "all this means that time is with us. Every day we hold on weakens the railroads and strengthens our hand." Mr. Carroll, of the maintenance of way workers, talks of the railroads first "whipping" the shopmen, then "whipping" the maintenance workers. He attributes to the roads the "old strategy of divide and conquer." Samuel Gompers pronounces the Labor Board "a fifth wheel" and believes that direct negotiation between roads and men would be more fruitful. He waxes cynical over the idea of government restraint on violence. To listen to all this, one would scarcely realize that the wages and terms against which these men are striking have not been imposed by arbitrary railroad managements but have been arrived at after a thoroughgoing hearing by a government tribunal established for the purpose. The issue of the railroad strike, then, is whether we shall hold the gains we have made in the settlement of industrial disputes by peaceful means or whether we shall revert to the rule of violence, with the public in the role of innocent bystander.

The Trend of the Coal Strike

IN the answer of the miners' unions to President Harding's proposals for an immediate resumption of coal production, there is little indication of a desire to compromise the present differences. Their action appears to be more in line with the traditional policy of holding what they have and reaching for more. The former we find in their objection to a temporary wage revision pending a reorganization of the industry. The latter is embodied in their contention that the plan must be accepted also by the non-union properties that have been affected by the strike. Such a condition would be an indirect, but none the less effective, means of extending union influence into fields from which it has hitherto been barred. The proposals having been rejected by the unions, a majority of the operators express a willingness to accept them; but the division of their answer on a district basis as well as the tenor of their statements indicate extreme reluctance to abandon the principle of district, as opposed to general, negotiation. And so, whatever may be the intentions of the several parties to the controversy, it looks just now as though they will succeed in throwing the coal industry into the lap of the government.

Return Flow in Irrigation

THE change in irrigation from the crude rule-of-thumb methods of the pioneer to the careful engineering design and operation of the present day is notable. Much of this change is an incident of the progress that comes with the settlement of new country and the growth in experience and in available capital. State engineering departments, the more progressive and public minded irrigation companies, agricultural experiment stations, the United States Department of Agriculture, and perhaps, greatest of all, the United States Reclamation Service, have all had their part in putting irrigation on a scientific basis. Of the many lines of engineering study that have been carried on one of the most significant has been concerned with the return flow of water from irrigated lands to the streams for possible re-use. The review of such studies by Mr. Meeker elsewhere in this issue will repay study. Among other things, it shows that half or more of the return

flow occurs during the irrigation season and is available for re-use. This sometimes requires artificial drainage, which is now so large a factor in successful irrigation. With far more land needing water than there is water for the land, and in view of the relatively small portion of a given diversion that gets to the irrigated area, as Mr. Meeker points out, the economic importance of any study that will lead to the beneficial use and re-use of every possible drop of water is evident. Return flow and similar studies deserve encouragement and their results should be given wide publicity.

Logical Fire Fighting

WORK started by the Chamber of Commerce of the United States to fight fire dangers and bring about a reduction of fire losses, as noted in the news pages, is a logical and effective step toward dealing with fires. It enlists for the task of fire-fighting those people on whom the loss falls, and who therefore are most deeply concerned, namely, the business men of the country. *Fire losses are paid by the public, not by the fire-insurance companies*, and the more thoroughly this fact is hammered into the consciousness of everybody and its full significance is grasped, the more progress can we make toward wiping out the unnecessary fire loss. Work of the utmost value has been done by the Fire Underwriters, the National Fire Protection Association and other organizations of the insurance people, but such work is always at long range and cannot reach the chief evils directly. Its effect is therefore limited, and often in absurd disproportion to the effort applied and to the value of the results that might be obtained. Work under these conditions will naturally use means that are sometimes too weak, sometimes too severe, as important voices in the electrical field have lately urged. But where the work is taken in hand directly by those whose pocketbook is affected, namely by the insured—that is, by the public—each item of effort will have its proper measure of effect, and the measures adopted in the campaign may be most fitted fairly to the particular needs of the situation to which they apply. The move of the Chamber is to be welcomed as a definite promise of progress in fire fighting. It will have the support of every medium of public information and opinion in the country.

Amateur River Control

WHEN the editor of the *Saturday Evening Post* read the page proof of Harris Dickson's story of the Mississippi flood fight in last week's *Post* he must have overlooked the following sentences—"In this sweet and gentle springtime old folks discuss the levees, and a young man's fancy lightly turns to thoughts of river control. Behind receding waters the usual crop of crossroad theorists is sure to germinate. Each one presents a sizzling panacea, and writes a piece to the editor. They orate at public meetings, get red in the face, and sweat like a negro under oath, seeking to convince a bunch of stupid professionals who persist in doing the wrong thing." If the editor left this bit of truetalk in on purpose it must be in testimony of his conversion from his rather hysterical state when he wrote the editorial in his issue of June 10 entitled "Our Runaway River." That editorial does not confine itself to one "sizzling panacea"; it goes the whole hog—diversion dams, reservoirs, retention basins, reforestation and contour plowing—but worst of all intimates that through malevolent conspiracy or dense ignorance the engineering profession has prevented the application of these obvious remedies. If the editor will read, among other things, Col. Townsend's admirable paper "Control of River Floods" before the Drainage Congress at St. Louis in 1913, he will find that his cure-alls have all been examined, evaluated and, as major remedies, rejected by men who have spent a life-time in expert study of the problem. Unless the amateur in so important a national issue is prepared to refute the expert by book and verse his vague generalizations in opposition become ridiculous, though when backed by the wide circulation and responsibility of a national journal they are dangerous. The editor of the *Saturday Evening Post* owes the engineering profession an apology.

Bridge versus Tunnel

A MOST interesting controversy is now in progress in the region surrounding Newark Bay, one of the lateral branches of New York Harbor. Since early days the bay and its entering streams have been crossed by bridges, forming indispensable traffic links between New York and other Hudson River communities and the country to the west. Recently a determined effort has been made toward the ultimate clearing away of these bridges, so that unobstructed navigation space may be available for the commercial exploitation of the bay shores. Newark interests chiefly are back of this movement, with considerable backing from the New Jersey Board of Commerce and Navigation, which has strong Newark representation. The original point of attack was the proposal of the Central Railroad of New Jersey to renew its bridge between Bayonne and Elizabeth, at the mouth of the bay, a long timber trestle with double bascule draw. Determined opposition was made to this proposal from the first, and the Newark interests now demand that a tunnel be constructed in place of the bridge crossing, though the cost of a tunnel would be prodigious, and no showing has yet been made that commensurate economic advantages would be obtained.

A second opportunity for urging the replacement of a bridge by a tunnel came within the past month through the destruction of the Hackensack River drawbridge on the Lincoln Highway, just above the head of the bay, and such replacement is now under consideration. The active argument in such cases is always borne by interests with a direct financial concern, but the real questions at issue relate broadly to the ultimate public good, and lie beyond the reach of narrow considerations based on local or personal advantage.

Before any valid conclusion can be formed, the relative rights of navigation and of land traffic require to be appraised. Since such appraisal calls for intimate knowledge of the conditions and a far-seeing view of future development, it would be of greatest value if the War Department, which is charged with the final decision in at least one of these cases, seizes the occasion to enter into a thorough study of the conflicting claims of land and water traffic, especially in those most contentious cases where the land traffic is real and the water traffic is largely speculative. The conflict between the two is increasing at many points throughout the country, and the old principle that navigation rights

are paramount, though outlived by events, serves only as a disturbing factor. It is time that the basic principles of adjusting the two kinds of traffic were established; and in view of the many disturbing local elements that becloud each individual case, it would be best if they could be formulated in such general terms that they might serve as a guide in shaping the decision in any individual case, present and future.

The Making of Definitions

IN all probability the greater part of the engineering profession and its allied businesses consider the making of definitions trifling sort of work for men who are designing and building the world's structures and machines. There are dictionaries and encyclopedias where things are defined and when these authorities fail, as they so often do in engineering matters, there is the common acceptance of the term to fall back on. Why waste valuable time trying to torture a lot of words into defining what another word means? Leave that to the philologist in his study.

Fortunately there are a certain number of engineers who appreciate the necessity for precise and authoritative definitions, who have had enough experience in contract interpretation and with judicial inquisitiveness to realize that so far as possible every word the engineer uses in his work should have an unmistakable meaning and that groups of qualified engineers should put on record such accepted meanings, or lacking a general acceptance, should set forth a majority understanding of the word in the hope that this will gradually become unanimous. These men are in the various technical societies, which pretty generally have appointed nomenclature committees for this purpose. Such committees are doing a useful and difficult work, but it is doubtful if either its utility or its difficulty are properly appreciated.

As an instance there is recalled the recent deliberations of a committee on the definition of so simple a material as sand. After much discussion there was evolved the definition that sand "is the loose granular product resulting from the natural disintegration or mechanical reduction of rock," which seemed to take care of the appearance, composition and source and to cover the various interpretations of sand in the different arts. Outside experts called in immediately began to raise questions. What is a grain? What is rock? Is crushed slag sand? Under this definition, purposely written so as to include the mechanically reduced product known as sand in foundry practice, would not a concrete engineer be required to specify "natural" sand if he had objections to the use of crusher reduced rock as sand? Thus it appeared that sand is not easy to define but that at the same time its exact meaning might well become a matter of the greatest importance.

In some fields the necessity for definition becomes more a question of a nice precision than of technical or possibly financial importance. For example there is unnecessary confusion of terms in river and shore protection work. Jetty, we think, is properly applied only to a roughly paralleling current control structure at the mouth of a river. Yet it is variously applied to walls built out from the shore at or near a right angle, a structure which properly should be called a groin when built into a currentless lake or ocean and a spur dike or diversion dam or wing wall in a river; it is even sometimes applied to a mole or breakwater, which serve quite different purposes. There is a whole galaxy of words in this field to which meanings should be pinned down. Just what is a dike and how does it differ from a levee? What would you call an earth-fill built across a reservoir to permit the emptying of a part of the basin at a time?

Questions such as these are somewhat more than academic. To settle them requires a wide acquaintance with the field and a knowledge of the mechanics of language. It will not do, for instance, to define a certain kind of cement as "a cementitious substance which etc., etc.," as did a committee of a leading technical society some years ago. And as any one who has ever served on a nomenclature committee knows, difference of opinion as to well known words is astounding. There should be a better appreciation of the necessity for consolidating such opinion and a greater effort made to perpetuate such definitions as are accepted by those who are engaged in formulating them.

Must We Stick to the Wheelbarrow?

THE two papers presented to the American Society for Testing Materials and abstracted on another page are merely an indication of the amount of study now being given to proper methods of proportioning concrete. Not only are many laboratories in the midst of extended tests, either self-initiated or as a part of committee study, but concrete contractors are beginning to appreciate that something better than the old straight volumetric proportioning will increase both economy and safety and are making experiments on their own account. There still remains an undercurrent of feeling—mostly among those who pride themselves on being called "practical men"—that all of this study is fancy work and that the good old 1:2:4 mix is what the concrete man will put in, no matter how many odd decimal places the laboratory adds to the figures in the proportions.

The wheelbarrow, some of these men say, is the natural and foreordained unit of measure for aggregate and the wheelbarrow cannot possible be marked or manipulated so that a batch will be fed, say, 1.732 parts of sand and 4.351 parts of stone. Some few theoretical concrete people may use weighing machines or measuring boxes, but the line of man-pushed wheelbarrows will continue to grace every real concrete job so that there is no use suggesting any method which will not lend itself to that ancient and useful vehicle.

This is a reactionary view. Doubtless much of the concrete put in today is being proportioned in wheelbarrows; but so, too, is much of it being mixed too wet or too short a time or with insufficient cement and unsuitable aggregate. Whatever is is not necessarily right. If there were any insurmountable difficulty in using measuring boxes or hoppers or even weighing machines, a continuation of the variable wheelbarrow standard might be continued and improvement in quality of concrete sought elsewhere, but thousands of yards of good concrete placed by reputable concerns cheaper and easier than with wheelbarrows are testimony to the possibility of using the apparently complicated decimal mix. Trade practices are not immutable, as the study of any trade will show. Education can do much to bring about changes, especially when the old methods have little to recommend them except tradition.

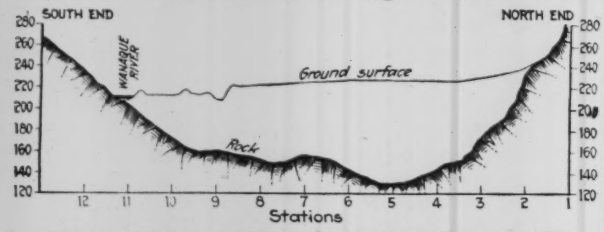
Core-Wall Construction in Deep Trench at Wanaque Dam

Maximum Section 20 x 90 Ft.—Sheeted with Two Lengths of 50-Ft. Steel Sheet Piles—Trenching and Concreting Plant and Methods Described

By Arthur H. Pratt

Chief Engineer North Jersey District Water Supply Commission, Newark, N. J.

A CORE-WALL trench only 20 ft. wide and at its maximum section 90 ft. deep, has been successfully constructed for nearly 900 ft. across the valley to be closed by the Wanaque Dam in northern New Jersey. With the exception of two accidents, neither of which caused much damage structurally but which, unfortunately, caused the death of workmen, there were no difficulties in excavating the trench or in concreting the core-wall which were not successfully handled by the methods employed. These were to drive full-depth steel-pile sheeting and excavate between the walls, which were braced apart with timber as the trench deepened, and then to fill between the sheeting with concrete until



LONGITUDINAL PROFILE OF WANAQUE DAM SITE

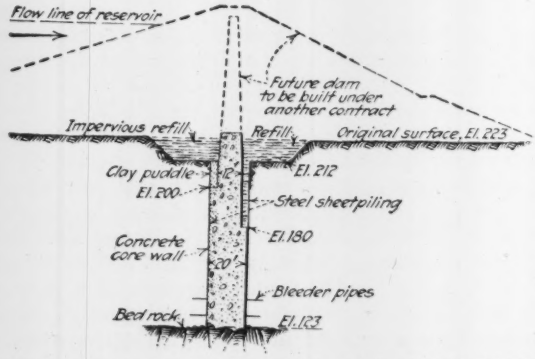
near the surface where the wall was thinned down and was concreted between forms. The unusual task was driving the long sheet-piles and supporting the high walls during excavation and concrete construction.

General Description—The Wanaque Dam is being constructed to impound water for Newark, N. J., and neighboring municipalities. The reservoir is about 25 miles from Newark, will be about 6 miles long and will store not less than 11,000 million gallons, giving a yield of some 50,000,000 gal. daily from the proposed first development, though greater storage can be provided.

The site of the dam is across a valley about 1,500 ft. wide which it is proposed to close by means of an earth embankment having a concrete core-wall extending to bedrock. This rock, a gneiss, outcrops on both hillsides but at the bottom of the valley dips to about 100 ft. below the surface. The overburden is sand and gravel, and of course bears an enormous quantity of water. The present channel of the Wanaque River crosses the site of the dam near the south end and the river bed is partly on the ledge rock which gradually dips away from the river to the deepest place near the middle of the valley. As already stated, the method adopted to construct the core-wall across the valley was to excavate a sheeted trench and then fill it with concrete. This trench is sheeted with Lackawanna arch-web, 35-lb. steel piling braced with timber. Previous to putting down the sheeted trench, a stretch of open cut, with sloped sides, was taken out with a steam shovel, giving a level path upon which to erect the frame for guiding the piling and for working the two pile-driving rigs, one on each side of the trench. These rigs have an A-frame 75 ft. high, with an extension to a total height of 92 ft., giving a clearance sufficient to handle and mesh one 50-ft. pile into another when the latter has been driven about 10 ft. Each rig is equipped with a Vulcan No. 10 steam hammer and is mounted on skids which slide on sills laid normal with the trench.

Pile-Driving Methods—First a portable guide frame 48 ft. long made of 12 x 12-in timbers was set up over the deepest part of the trench. This frame was constructed so that it could be adjusted to various widths. The aim originally was to obtain a trench 20 ft. wide at the bottom. As there was no experience upon which to determine the probable deviation of sheeting for such deep driving, the trench was started with the guide frame set to a width of 22 ft. After the piling was driven, the average top width was found to be actually 21.5 ft. The deviation from vertical before striking rock was found to be about 6 in. for each wall of piling, sometimes wider and sometimes narrower than the width at the top. On top of the rock the slope of the ledge surface forced the piling out of line so that the narrowest trench was 18.6 ft. and the widest was 24.4 ft.

A wall of 50-ft. steel piling was set up on each side of the guide-frame and driven into the ground a few

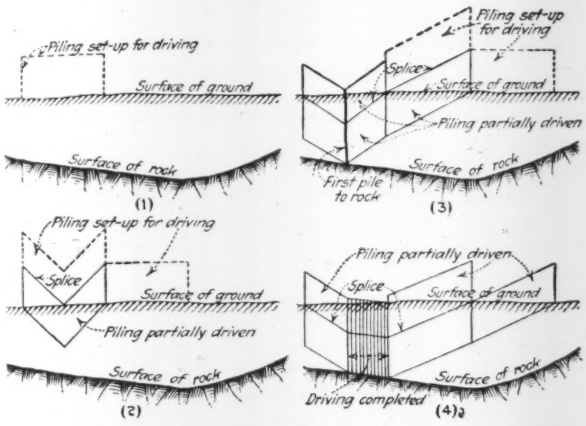


SECTION OF DAM AT MAXIMUM CORE-WALL DEPTH

feet so as to hold the toe in place. Extreme care was exercised for the first set to have the piling true and plumb in both planes. This precaution has been found to be very important as the first piles driven serve as pilots for the succeeding piles. Succeeding frames were, however, also set up very carefully. After the first wall of piling was erected driving was begun on a set of three piles at the middle of the frame. When the first three piles were driven a few feet the adjacent three on each side were driven and so on, the rule being in general to drive no pile more than 4 ft. in advance of its neighbor. This method was continued until the middle pile of the set was down with its

top to the surface of the ground, the bottoms of the adjoining piles then being in staggered diagonal lines to the surface of the ground. The frame was then moved ahead and another frame-full of piling was set up adjoining the first. Then driving was resumed until the new set and adjoining members of the first set were down to the surface of the ground except that the end piles were always left stepped-up in approximately 4 ft. steps.

As required, additional lengths of piling were spliced on top of the lower set by means of a 7-in. channel and a $\frac{3}{8}$-in. x $6\frac{1}{2}$-in. plate, bolt-holes to fit being previously punched in the ends of the piles. Driving on the spliced piles was suspended on each driving set when it had preceded its neighboring pile by 4 ft. In this manner, by gradually working the wall down in a



SEQUENCE OF OPERATIONS DRIVING STEEL SHEETING

slanting line, the bottom of the steel sheeting finally intersected the line of rising rock. By this method, while the first frame was set up over the deepest point, the first pile to strike rock was some 50-ft. to the south. Driving to rock continued then until the rock outcrop at the north end of the dam was reached.

The lengths of piles to be driven were predetermined by scale from the rock profile developed by the original borings. While the actual profile checked out as nearly as could be expected from the borings, still the rock bed was very uneven and it was later found desirable to make careful soundings, with the pile-driving rig and a steel rail, on the line of piling to determine the appropriate lengths of piles more accurately in advance. After the sheeting had been extended to the north end, the pile-driving rigs were moved to the other end of the walls of piling, the frame was set up and the same methods used extending the sheeting toward the south end of the dam. When possible sets of three piles were driven at one time but when the penetration became difficult two piles were driven and finally for the deepest part only one pile was driven at a time. The maximum length of penetration was 84 ft. and the slowest driving in that vicinity was some 90 blows to the inch.

A typical gang consisted of 1 foreman, 1 pile-driver operator and 6 pile-driver men for each pile driver. Two rigs were run under one general foreman and high pressure steam was supplied from a central plant so that a fireman was not usually employed with the driving rig. Pile-driving progress for two rigs is shown in Table I.

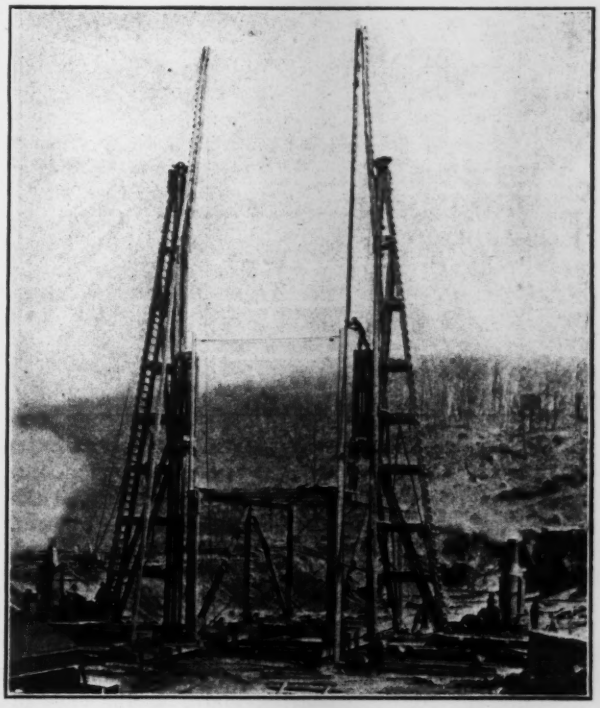
Method of Excavation—As soon as the driving rigs were moved to the southerly stretch, excavation at the north end was begun with clamshell buckets operated

TABLE I—PROGRESS OF DRIVING OF STEEL SHEET-PILING

Month	Sq.Ft.	Month	Sq.Ft.
April, 1921	5,600	November	900
May	6,500	December	200
June	9,200	January, 1922	100
July	14,700	February	15,800
August	5,200	March	6,000
September	6,600	April	9,900
October	12,800	May	6,400
		Total	99,900

from stiff-leg derricks running on a track on top of the west bank. The excavated material was hauled directly to the downstream dam embankment when possible.

As fast as the trench was excavated it was supported with 12 x 12-in. braces in bays 10 ft. on centers and wales and braces spaced 6 ft. apart vertically for the upper 32 ft. of the trench. Below this the spacing was reduced to 3 ft. vertically and subsequently altered to double sets 6 ft. apart. Rangers 14 x 14-in. and 12 x 14-in. braces were used for the lower section of the trench. Ground water was encountered at once and pumping began after the installation of the top set of waling and bracing. Two 8-in. discharge, Morris Machine Co.,



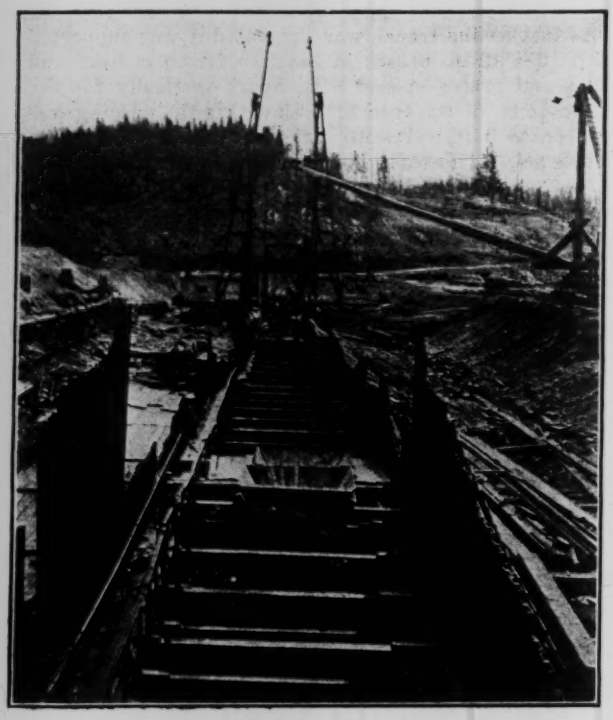
PILE-DRIVING RIGS AND GUIDE FRAME FOR CORE-WALL

60-in. diameter, centrifugal dredge pumps were installed and dredged a considerable yardage of sand and gravel out of the trench, depositing it on the downstream dam embankment, besides pumping water. The total pumping equipment used on the job in addition to the dredge pumps was as follows: Four No. 9 Pulsometers; two 5-in. Emersons; two Lawrence 5-in. electric centrifugals and one Worthington electric 100-hp. 6-in. discharge, centrifugal. The quantities of water pumped are given in Table II.

TABLE II.—MONTHLY OUTPUT OF TRENCH PUMPS IN MILLIONS OF GALLONS

March, 1921	.6	November	85.8
April	1.9	December	90.5
May	.2	January, 1922	81.0
June	3.2	February	70.5
July	41.5	March	120.3
August	138.9	April	115.8
September	102.4	May	116.6
October	101.2	June	114.4

Due to the porosity of the material and the low rainfall, the ground water level was very considerably lowered during the fall and winter of 1921-22. In general it remained about 20 ft. above the water level in the trench. The result of this lowering of water level was appreciably to reduce the pressure on the timber bracing. After a few timber sets had been put in and the trench excavated about 40 ft. deep the bracing began to show strain; one wale cracked longitudinally in about the middle, some of the bracing cut into the wales as much as ½ in. and some of the braces split at the ends. The use of iron bearing plates at the ends of the braces had been proposed and a closer vertical spacing was considered, but the only change actually made was to substitute oak for pine bearing plates at the ends of the braces and to frame the timber with extreme care to be sure of a bearing over the entire 144 sq.in. section.



TIMBER BRACING BETWEEN TRENCH WALLS

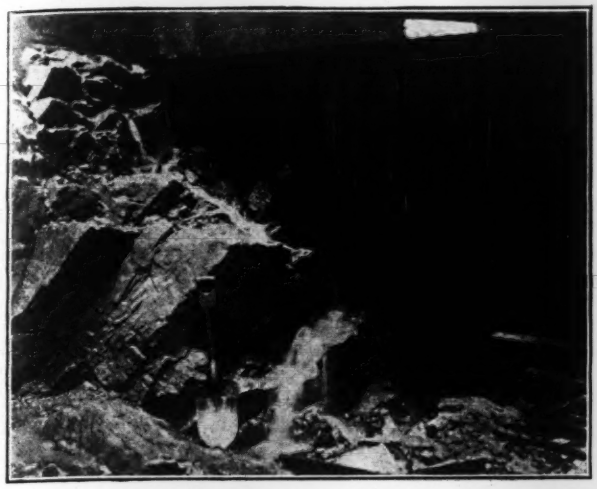
As the trench was deepened the ground water dropped and the pressures have apparently never again reached those which obtained in the more shallow trench. Most of the braces when removed were sawed and cut out without great difficulty and some could be pulled out with a cable from a derrick hoisting engine.

Accidents Due to Cave-In—As the excavation reached the bed rock beginning at the north end, the condition of the contact of the steel piling with the ledge was inspected with considerable interest. In general this contact was found to be most satisfactory but in a few places the piling had encountered rock fragments near the bottom and had been twisted out of its interlock. There were a few piles that had been overdriven and "fishhooked." With the pressure of ground water of about 20 ft. and a considerable flow under the piling at the bottom some apprehension was felt as to the certainty of the bond between piling and rock so that a small pile hammer was rigged on a derrick set upon the berm of the sloped excavation for the purpose of redriving any piles not driven to the rock.

On Nov. 2, 1921, absolutely without warning, a cave-in occurred about 200 ft. from the north end of the core-wall and about 8 ft. outside of the sheeting. A hole said by eye witnesses to be about 5 ft. in diameter and 12 ft. deep opened up under the feet of several mechanics who were working under the new derrick rig and one man was submerged. It was necessary to move the rig out of the way before workmen could dig for the man and soon after digging began it was found that sheeting would be necessary to hold the ground to reach where he might be. A temporary sheeted wall was put down and this was later inclosed by a framed timber shaft but all to no avail and the body was not recovered for several days and not until an 11-ft. square shaft of 35-ft. steel sheeting was driven inside the timber set put down after the temporary set. The body was finally recovered at a depth of 32 ft., about 30 ft. above rock.

After this occurrence the driving rigs were pulled back and all piles between which any excavation had been made were redriven to insure a close contact with the rock. This redriving resulted in an additional penetration of generally from 6 in. to 1.5 ft. though a few single piles were driven as much as 3 ft. and one was driven an additional 11 ft. Some did not budge upon redriving. The completed excavation indicates a satisfactory contact of piling with the rock. In a few places where it was not good special precautions were used such as piling sand bags; some bent and torn piling was burned off. In one especially bad place a short set of additional piling was driven at the bottom of the trench inside of the first set.

Method of Concreting Core-Wall—As soon as the earth was cleared away from the northerly end of the trench, the concreting of the core-wall was begun. Aggregate is obtained from a gravel bank about one-half-mile away from the core wall on the opposite side of the river and located on a terrace about 35 ft. above river level. The material is excavated by means of a 40-ton steam shovel, hauled to and run through a crusher and a revolving screen. The portion of the output of the screening plant which can be used at once is hauled directly to the concrete mixer and the remainder is stored in the excavated part of the pit for future use. There is about 50 per cent of excess sand in the pit which has to be wasted. The concrete mixing plant is located 300 ft. from the core-wall trench and consists of aggregate storage piles feeding into bins by a derrick and two Ransome, size 63 mixers. Mixed concrete mostly proportioned 1: 2½: 5 is deposited in bottom-dump buckets which are hauled to the core-wall trench on narrow-gage flat cars and then transferred by stiff-leg derricks on the west bank to the concrete forms. In the bottom of the trench on account of the

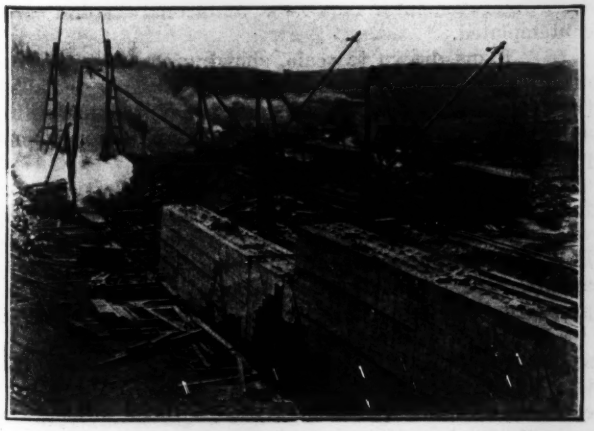


IN TRENCH BOTTOM CONTACT OF PILES WITH ROCK

interference of timbering, concrete was placed through hoppers feeding into a vertical 10-in. steel pipe.

Concreting was begun at the shallow portion of the excavation at the north end and proceeded southward as the trench was deepened. In the first part of the work the water in the bottom was handled with no difficulty by means of blind drains or pipes on the sides of the trench next to the sheeting, but as the deeper portion of the trench was reached the water increased in quantity and began to interfere with placing concrete. In the deep trench the ground water back of the sheeting began to leak through and flow onto the concrete up to a level some 20 ft. above the bottom of the trench.

To obviate this trouble holes were burned in the sheeting near the bottom and 2-in. pipes, 3 or 4 ft. long, pointed and perforated were driven into the earth. These acted like well points and drained the water away from the back of the piling so that the flow into the trench was largely confined to these bleeder pipes and was easily controlled. The bleeders were also useful in holding the ground water level down so that there was no difficulty in placing the second layer of concrete. For the concrete in the deepest section additional precautions were used. The concrete was placed in short stretches—10 or 20 ft. long—and first a concrete bulkhead about 6 in. wide and 2 ft. high was built on either side about 2 ft. from the sheeting. Back of this wall a blind drain or pipe—sometimes connected with the bleeder pipes—carried the water ahead. Between these bulkheads concrete could be placed in the dry and afterwards the space back of the bulkheads was concreted—blind drains and drain pipes being cut off periodically.



UPPER PART OF CORE-WALL UNDER CONSTRUCTION

Concreting was carried on from the north end of the trench towards the middle until the deepest point in the excavation was reached, Sta. 5 + 00, where the principal pumping plant was located. Operations were then undertaken part way across the valley near Sta. 7 + 50 at a point where there was a natural sump in the rock. Here another pump was installed and operations by the same methods as used before continued in the opposite direction until the gap between the new pump and the main pumping plant was filled. Then the closure at the deep place was undertaken, the space between the finished sections of core-wall being about 40 ft. Parapet walls 6 in. wide were built longitudinally across this stretch about 2 ft. inside of the sheeting and the water which came underneath the piling or through bleeder pipes was concentrated on either side between the parapet and the steel piling, leaving the center clear and dry to be filled with concrete. When the center wall had been carried up about 6 ft., the spaces betwen the parapets and the steel piling were filled with rock fragments and the top was sealed over with concrete from one wall of steel piling to the other leaving vertical steel pipes built into the concrete for pump suctions and float wells. The pumps are arranged in three sets, one having its suction on the upstream side, the second on the downstream side and the third so that it can be switched to either side when one set of pumps of the three is being raised. By this means, alternately raising one pump at a time and concreting under it and building the suction pipes up, the closure in the deep section is being accomplished. Meanwhile concreting is proceeding at the river end of the trench where the rock is not so deep.

The quantity of water at the sump at Sta. 8 + 00 is about 600 g.p.m., while at the date of this writing the quantity of water in the deep sump is about 1800 g.p.m. At the present progress of concreting it is apparent that the rest of the trench will be closed before the deep section can be finished so that the pump suction pipes will probably be extended upward to the river level and when pumping stops the suction pipes and pump suction chambers which were filled with broken stone will all be grouted. In any event there is a tight concrete wall at least 10 ft. thick between the two sets of suction pipes.

The refill on the upstream side of impervious rolled material and on the downstream side of sand and gravel —probably placed by hydraulicking—will complete the present contract. A contract for the remainder of the dam will follow.

Personnel—The North Jersey District Water Supply Commission consists of Laurent J. Tonnele, chairman; Wood McKee, Obadiah C. Bogardus and Thomas L. Raymond. Morris R. Sherrerd is consulting engineer; Arthur H. Pratt, chief engineer; Neil C. Holdredge, assistant chief engineer in charge of construction and Arthur L. Sherman, designing engineer. The contractor, W. H. Gahagan, Inc., Walter H. Gahagan, president, is represented on the work by Ralph C. Young, superintendent and H. B. Wheatcroft, assistant superintendent. J. Roy Horton of Buffalo was subcontractor for the steel sheet-piling work.

Plant Inventories Offer Field for Structural Engineer

Strong Need for Adequate Data on Factory Properties and Equipment — Detailed Methods on How Best to Present Accurate Picture

By Francis W. Wilson
Wilson Engineering Corp., Hanover, Mass.

In PERIODS of industrial depression when construction is at low ebb engineers should give attention to the possibilities of income from other sources. The preparation of neatly-executed, clearly-expressed inventories of buildings and equipment for existing factories or industrial plants offers an extensive field for the employment of structural engineers. It is true that there are large concerns specializing in this line of work, but even a hasty glance at their methods would be sufficient to suggest to a structural engineer opportunities for improvement.

Not that these concerns do not do their work in a thorough manner, but generally their scheme of recording the information is largely clerical. So far as structures are concerned a mere listing of material is vague, whereas photographs and drawings showing the construction are more valuable and convincing.

For example, on one such inventory the writer noted that wooden roof trusses were described only by a bill of material. The actual construction of the roof trusses could not even be surmised from this information. A simple line drawing of the trusses with the sizes of material marked on each member would have been much more enlightening. However, it must not be assumed that inventories prepared by concerns who make such work their sole business entirely neglect the value of drawings as a means of recording the information.

Usually floor plans of the buildings are prepared and these show locations of machine tools, shafting and other items. Such drawings, however, are, as a rule, lacking in completeness in indicating construction features.

The set of blueprints furnished with the usual plant inventory is (in all cases that I have personally observed) fastened together by clips, and rolled up along with typewritten schedules and information covering the listing and description of other items of the buildings and contents. Such a system is lacking in clearness, accessibility, and permanence.

Keep in mind the fact that there is nothing which so quickly or clearly conveys an impression, as a "picture" of an object. Remember that the factory owner who employs you to prepare such an inventory will take a pride in it, and tell others about it, if he can without mental effort, see on the pages of a book, his entire plant spread before him, page by page, in "pictures."

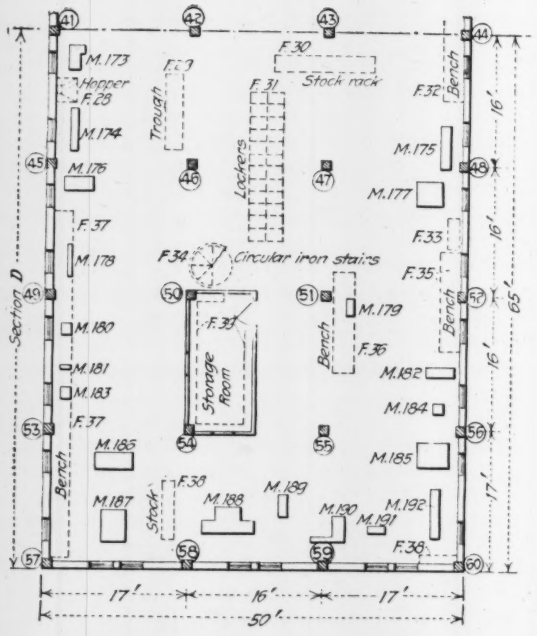
To many business men blueprints are expressionless and mysterious, but with records of the kind described here, a factory owner will delight in consulting them frequently because it is easy to take the book from the safe and turn to the pages illustrating any portion of the plant which he desires to study.

As to the demand for such inventories there is practically none, but there is a great *need* for up-to-the-minute data of the right kind. The demand must be *created*.

Why Inventories are Valuable—There are at least four good reasons why a manufacturer finds a plant inventory valuable, and worth much more than its cost. Briefly stated, these are:

(a) In case of a destructive fire he can show the insurance company convincing data as to just what has been destroyed.

(b) It furnishes reliable data on which to base the proper amount of insurance to be carried by the factory owner.



CHARACTERISTIC PLAN SHOWING ALL ITEMS MARKED

(c) It supplies a basis for obtaining bank loans in case improvements requiring additional capital are contemplated.

(d) Plans drawn to scale, showing the grouping of machines, the relative position of stock, the installation of apparatus, etc., provide the manufacturer with an opportunity to study the efficiency of his producing plant as a whole, or in its various units.

Field for Plant Inventories—The most fertile field for securing work in this line is naturally in plants where the buildings are of cheap wooden construction. It is there that an engineer will generally find the owner an attentive listener as he unfolds the details of the proposed book of data.

The following description is not supposed to represent the last word in the preparation of such inventories. Any bright structural engineer may see many opportunities to improve on these suggestions, both as to methods of obtaining the data, and as to the manner of recording it.

Method of Procedure—Sometimes the owner has a set of plans and specifications for the building as originally constructed. If so, they will materially reduce the labor of preparing the inventory, but do not accept these old plans as correctly representing the buildings as they exist at the time your work starts.

You will generally find that there have been many changes. Perhaps a stock room has been partitioned off in one corner, the offices have been moved into another building, a new loading platform has been added, another elevator has been installed, etc. After a matter of ten or fifteen years factory buildings have often grown away from the original plans until they agree with them only in a general way. Take nothing for granted. Compare every detail with the plans (when there are plans) and note all alterations, additions, and new features.

Frequently you will find that the owner employed no mill architect, and had no plans prepared for his buildings. Some "builder" perhaps made some rough drawings at the time of construction, but these were never seen after the completion of the work. In that case, it is necessary to prepare a set of floor plans of the buildings, made from actual measurements. No elevations need be made, for photographs will better tell the story. A few cross-sections are necessary in order to show story heights, and other features which cannot be clearly shown on plans.

The first thing to prepare is a block plan of the entire plant. This should show spur tracks, loading platforms, the position and dimensions of buildings, loading cranes, foot-bridges between buildings, stack, stock racks, tank towers, and all features which can be indicated on a small scale block plan.

Next, decide on the size of the book in which the complete inventory will be bound. Data of this kind simply rolled up like a set of drawings, and held together only by clips are in very undesirable form. A sheet can be too easily removed, and often will not be replaced. Decide on a uniform size of sheet, and when the information is complete have the loose leaves neatly and securely bound. The size selected for the pages of the book will depend somewhat on the dimensions of the individual buildings, and on the scale to be used for floor plans. A scale of $\frac{1}{8}$ in. = 1 ft. is desirable for all the plans.

A long narrow building can be divided into two or more sections when it comes to making the floor plans. These sections should be shown on the block plan, and clearly designated by letters or figures.

Notes and Sketches—A good method of making notes and sketches embodying information which must be collected on each floor of the factory is to have a plan of the floor on which this could be marked and sketched, preliminary to representing it on the finished plan. All the information cannot be sketched on any *one* plan of the floor under consideration without entailing undue confusion in the notes. To do this quickly and cheaply, resort is had to the hektograph. Hektograph copies can be quickly and cheaply made and afford the white ground on which to make sketches and notes.

The number of hektograph copies of the floor plans or sections into which a floor is divided will depend on the nature of the building and contents, but start out with enough of each. You will need one plan to show the floor framing; one for marking the location and size of machines; one for position and size of shafting; one for steam-heating pipes, coils and radiators; one for sprinkler pipes and heads; one for vent ducts; one for electric wiring and lights; one for plumbing pipes and fixtures, etc. Use one of these hektographed plans for each class of information.

In preparing hektograph plans, number each column, show partitions, and location of all windows, doors, location of elevator, etc. These features will serve as a basis from which to locate the other items, such as machinery, equipment, etc. Especially convenient in this respect are the numbered columns. Assign each wall and interior column a separate number, as you might on a steel erection plan. Then in the building, while working on any particular floor collecting the notes, tag certain columns with the number assigned to them, so that you can quickly identify locations on the floor with your working plan.

The Finished Book—In the finished book of data there must be one set of plans devoted to framing and floor and roof construction and another showing the location of each machine on the floor. By using different colored inks it is possible to combine the information relating to a number of items of equipment on a single set of floor plans.

Blueprints are not suitable for this work because water colors and colored inks cannot be used. The drawings on which the completed record is shown should be black-line prints on a good quality of strong white paper which will take water-coloring satisfactorily.

The black-line prints should have a border line of uniform dimensions and at the left hand side of the sheet there should be a margin outside of the border line to allow for binding.

The illustration herewith shows a small portion of a factory floor and the manner of indicating the position of machine tools and other fixtures on the floor. Machine tools represented in plan would have in many cases irregular outlines, but it is sufficient to represent them by rectangles of sufficient size to include extreme plan dimensions.

After all machines have been located and their approximate sizes and true positions shown on the floor plans, then, starting with the basement, or first floor plan, as the case may be, number each machine tool or piece of mechanism consecutively. Continue the numbering on each successive floor to the top of building.

Obtain from the factory owner the name, name of maker, maker's number (or model number), and the purchase price of each piece of machinery. The date of its purchase is also important. These data can all be recorded in a list on tracings of the size adopted, and black-line prints made from them.

Data on machinery are the only data in the inventory which the structural engineer is in no position to verify. The factory owner's books, cancelled checks, and receipted bills should be all the evidence necessary to substantiate the reliability of this schedule.

On the floor plan showing the location and numbers of the machines it is well also to show the shafting which is located in that particular story of the building. This can be done by heavy red lines on which, marked in red ink, the diameters of shafting can be stated. On the same floor plan locate all fixtures, such as

benches, racks, troughs, shelves, lockers, etc. In order that such fixtures may not be confused with the machinery draw the outlines of machines in solid lines and the outlines of fixtures in dotted lines (see illustration on p. 96). Also to make this distinction plainer, color machines and fixtures with different tints.

Each floor plan contains three separate sets of numbers applying to different kinds of items. The columns are numbered, the machines are numbered, and the fixtures are numbered. In order that these numbers cannot be confused enclose column numbers in small circles; prefix the numbers assigned to machines by the letter "M"; and prefix the numbers assigned to fixtures by "F."

All fixtures, as well as partitions, stairs and minor structural features, must be fully described, and the description supplemented by drawings whenever necessary. These descriptions can be typewritten. Use sheets of such size that either two or four of them can be blue-printed on a single page.

If the buildings contain a number of partitions it is well to also number them as "P—5," "P—6," etc.

It is not especially important what colors are selected to represent different materials or items so long as the plans indicate clearly what each color represents. For instance, yellow is appropriate for wood shown in cross-section; gray for concrete; red for brick; and blue or green for shading the rectangles which represent machines.

Photographs of the exterior of the buildings should be 8 in. x 10 in. in size. Enough should be taken to show, if possible, each side of each building. Underneath the photographs state in lettering which building is shown and give the approximate location from which the photograph was taken.

Estimates and Costs—It is assumed that any structural engineer worthy of that title is a careful, accurate estimator; fully competent to prepare a reliable estimate of the quantities of material contained in any ordinary structure or building.

After preparing an estimate of the quantities of material of the various classes included in the buildings, the matter of costs becomes important. There are several good books on estimating which give the "cost" in hours of labor for various items of building construction. Data of that kind are quite valuable for this purpose since it is an easy matter to find the hourly rate charged in the various trades. Any dealer in building supplies can furnish data as to costs of all ordinary materials.

As to the cost of equipment items, such as plumbing, heating, lighting, ventilating, sprinklers, elevators, etc., there are reasonably close methods of approximating the costs of all except possibly ventilating equipment and elevators. Concerns specializing in those lines can be consulted.

Of great importance to the clearance of the whole is a very complete, well-arranged index. In the index, under the heading "Machines," or "Machine Tools," the entire list of numbers assigned to them should appear and corresponding to each number should be the pages on which the item is shown or referred to. The same applies to the list of fixtures.

On the first page of the book it is well for the structural engineer who has compiled the data to execute a sworn affadavit as to their careful preparation and as to their verity. In any such affadavit the engineer should state any reservations which may be necessary, such as the description and cost of machinery supplied by the factory owner or by his employees.

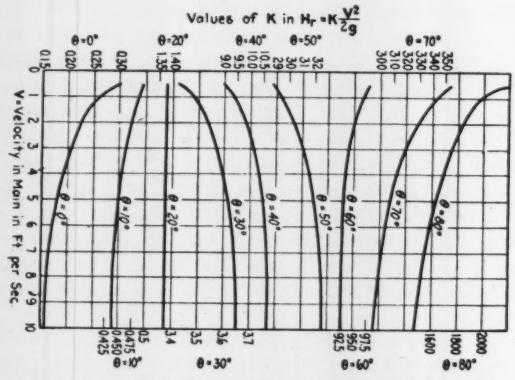
In the foregoing it has been the intention to call attention to a legitimate field for structural engineers, and give in a generalized manner suggestions as to methods which will appeal to the plant owners. Each individual who undertakes work of this kind will discover for himself labor-saving methods of acquiring and recording the information, and if he continues in such work for any length of time he will soon have at hand a vast amount of ready information as to costs which will prove of great value on subsequent work.

Losses in 6-Inch Butterfly Valve Varies Materially with Velocity

By W. S. Pardoe

Professor of Hydraulic Engineering, University of Pennsylvania, Philadelphia

RECENT experiments on the loss of head in a 6-in. butterfly valve indicate that the value of K in $h_f = K\frac{V^2}{2g}$ is not constant for a given value of θ but varies materially with the velocity in the pipe. The valve used was $\frac{1}{8}$ in. thick with a $\frac{3}{8}$-in. shaft as pivot. The angle θ is the angle between the valve and the axis of the pipe.



LOSSES OF HEAD IN 6-IN. BUTTERFLY VALVE
Tests show that K varies material for different positions of valve represented by angle θ.

The exponential expressions for the lost head h_f are as follows:

Angle θ	
0°	$h_f = 0.00405V^{1.785}$
10°	$h_f = 000755V^{1.97}$
20°	$h_f = 0.0214V^{2.00}$
30°	$h_f = 0.054V^{2.015}$
40°	$h_f = 0.144V^{2.067}$
50°	$h_f = 0.45V^{2.06}$
60°	$h_f = 1.50V^{1.985}$
70°	$h_f = 5.30V^{.987}$
80°	$h_f = 30.65V^{1.875}$

As the exponents vary from 2.00 except in the case of θ equal 20° the values of K will vary. This is shown in the accompanying curve. The values at 3 ft. per second do not vary materially from those of Weisbach, published in Merriman's "Hydraulics."

North Carolina Top-Soil Road Theory and Practice

Top-Soil Roads and Paved-Road Subgrades Conditioned to Carry Traffic Until Slab Is Laid

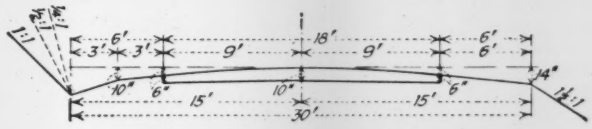
TOP-SOIL road construction, rationally developed, is rapidly giving North Carolina a system of improved highways reaching into every part of the state. These highways are in good condition 11½ months of the year; they are economically durable for a traffic of between 400 and 800 vehicles per day; they cost about $7,000 per mile to construct; they are maintained for about $400 per mile per year, and by resurfacing at a cost of about $135 per mile, say once in three years, they can be virtually renewed. When at last the traffic capacity of these top-soil roads is exceeded at somewhere between 400 and 800 vehicles per day, they provide remarkably good foundations for pavements of a hard-surface type.

Top-soil roads are an old type of construction in several Southern states. They have been constructed and maintained with all degrees of perfection but the work has been inferior perhaps more often than good. This has been particularly true of maintenance. Construction while frequently good has never been on a rational basis. When good it has been so because of a fortuitous combination of good local material and a builder experienced, or especially lucky, in selecting and working the material. If good the roads have demonstrated their ability to carry a moderate traffic nearly the full year at a moderate charge for construction and maintenance. Therefore, as employed in North Carolina, the top-soil road is a new development merely in the respect that certainty of good quality is being sought by rational construction and maintenance and that the type has been assigned a definite economic position in a balanced road system.

In North Carolina as in most states of large area and comparatively unimproved highways, the problem of road improvement has been to provide low-cost transportation as quickly as possible. The conditions, briefly stated, were: A law had been enacted providing for a system of state highways and investing control of the improvement of these highways in a state highway commission. A bond issue of $50,000,000 for highway improvement had been voted by the people and made available by the state legislature. Behind these actions was the expectation of the people that highway improvement would be realized quickly in a state-wide way.

To meet the expectation of immediate results, maintenance of existing roads was undertaken first. A state system of 5,500 miles was taken over and in four months was put under intensive patrol maintenance. In instances, this maintenance amounted to a substantial step toward reconstruction. The favorable effects were immediate. Attention was then turned to major improvement by new construction. The economic principle laid down for new construction was to adapt the road structure to the traffic conditions. Therefore in the industrial districts and between the large cities, paved roads were planned; in the farming country and between small towns permanent grades and structures, with wearing surfaces of selected materials, were planned, and in more remote districts it was planned to widen and drain the mountain trails and shape them up toward permanent grade and surfacing. In each kind of inferior road the work was designed to be a step toward a final hard-paved structure. Progressive construction was then the corollary of the principle of adapting the road structure to the traffic conditions.

In the classification indicated, top-soil roads are paved-road subgrades which are being kept in condition —by being constructed of selected materials and intensively maintained—to carry traffic until it is convenient and economical to put on the pavement slab. They are subgrade highways. As constructed they are in every respect a paved road lacking the paving slab. Location, profiles, dimensions, road bed, signs, drainage structures are final and permanent as if a hard pavement were to be built. The top-soil surfacing is the only task special to the type of road. The cost of



STANDARD TOP-SOIL ROAD SECTION

TYPICAL TOP-SOIL ROAD

this is practically only the cost of materials, which is $800 to $900 per mile, since the labor of placing is not greatly more than would be required to complete the subgrade for hard paving.

Top-soil is a disintegrated granitic rock from which the fine material has leached, leaving about 60 to 70 per cent grit and 40 to 30 per cent clayey residue not removed by leaching. It may be defined as a natural sand-clay. Besides the capacity for welding together into a mass of great hardness and strength, top-soil has the excellent qualities that it does not change volume with change of moisture content and that its capillarity is very low.

Generally top-soil is secured from tilled fields, but it exists in other places where natural conditions have induced a leaching action. Its occurrence in tilled fields is common of course because leaching has been activated by repeated upturnings of the soil in cultivation. The occurrence is in spots where leaching has been most active as on cultivated side hills. Its depth is usually 6 to 8 in. It is found in patches widely distributed but scattered. A tilled field may contain several patches of top-soil intermingled with areas of soil of the same origin but not leached or partially leached. The deposits are selected by visual inspection by men trained by experience to tell the best conditioned material.

Selection of top-soil requires to be put on a rational

basis. There is little difficulty in determining the most perfect material but as the quality shades off into soil of no value the selection by inspection is more difficult and the result is often in error. Studies are now in progress by the Division of Tests and Investigations to develop a qualitative field-test for top-soil. It appears from the results so far obtained that a combination slaking, shrinkage and strength test may be found practicable to make and reasonably determinative.

Top-soil packs down hard under traffic and assumes remarkable strength when dry. The roads fail by wear from the surface. Until recently, attempts to hold the surface by bituminous treatment have not succeeded. The light oils lack the binding qualities needed and the heavy oils form a mat which peels off. Experimental construction undertaken last year and being continued this year, indicates a possibility of developing a bituminous covering which will stay put. The process is to surface-scarify the old top-soil and then roll into it a single layer of broken stone about 2 in. in size. On this is spread enough top-soil to fill in the stone and slightly cover it. When the top-soil carpet has been worked by traffic well into the stone the surface is given a good dose of heavy oil. The stone furnishes an anchorage for the oil and it clings and wears remarkably well.

Maintenance is an essential factor in top-soil road theory and practice in North Carolina. Methods and equipment are ordinary. Dragging is the usual process. But it is essential that the maintenance shall be constant and conscientious. Faults must be remedied when they begin to show. Besides the rutting, which is characteristic of all earth type roads, corrugation and dusting are the principal surface effects of travel. Dry dragging has been found the best remedy for corrugation. Dust laying applications have the same action and efficiency, about, as on the more familiar gravel roads of the North. With the full perfection of a method of oil treatment as described in a preceding paragraph, the dusting problem will be solved.

German Technical Journals and High Printing Costs

High printing costs are having a seriously restrictive effect on the publication of technical and scientific periodicals in Germany, according to a note in the April 26 issue of *V D I Nachrichten*, the news edition of the *Zeitschrift des Vereines deutcher Ingenieure*. The figures in the case stands thus: Paper costs have risen from the 1914-1916 price of 0.38 M per kg. to 20 M per kg.; but the present price, which is about sixty times the pre-war price, applies to a lower grade of paper, and for equal grades the ratio would be about 100. Composing and press-room costs have multiplied by nearly thirty times. The cost in both instances rose only gradually up to the beginning of 1920, reaching three to five times the pre-war figures; then a very rapid rise set in, culminating in the summer of 1920, after which there was a stationary or slightly receding period, until in the fall of 1921 a new rise set in, at greatly intensified rate, the cost having more than tripled since that time. In the meantime, says the note, the subscription price of the journal has increased only fivefold. Considerably increased subscription prices are in prospect, and in addition the note forecasts increased rigor of selection of matter accepted for publication.

Large Concrete Floating Dry Dock Recently Launched at Triest

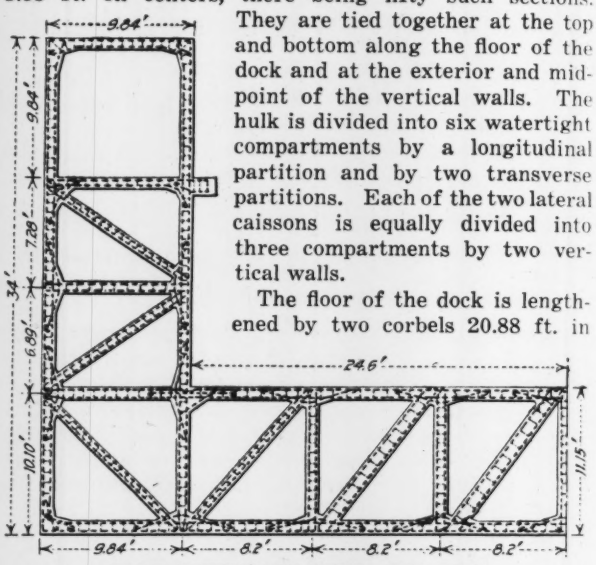
ONE of the largest reinforced-concrete dry docks recently completed has just been launched in Triest on the Adriatic Sea. The dock is designed for use by the port of Triest and for ships in the Adriatic Sea service only. The dock will accommodate vessels up to 2,000 tons displacement.

The principal dimensions of the dock are as follows:

	Feet
Length of hull	171
Total length, including corbels	210
Interior width	49
Useful width	44
Out-to-out width	69
Interior height	23
Total height	34
Maximum draft	16.4

The steel framing of the dock is composed of U-shape sections built up of latticed girders and set transversely 3.35 ft. on centers, there being fifty such sections. They are tied together at the top and bottom along the floor of the dock and at the exterior and midpoint of the vertical walls. The hulk is divided into six watertight compartments by a longitudinal partition and by two transverse partitions. Each of the two lateral caissons is equally divided into three compartments by two vertical walls.

The floor of the dock is lengthened by two corbels 20.88 ft. in length which extend the useful length of the dock and facilitate receipt and delivery of material. Each of the two lateral caissons is 9.84 ft. wide.



HALF SECTION OF STEEL FRAMING

These steel U-shape sections were built up of medium steel shapes spaced on 3.35-ft. centers. The odd-foot dimensions shown are due to reduction from meters to feet.

Caissons are dewatered for floating the dock by three centrifugal pumps placed in the lower compartments of lateral caissons. Water is discharged through pipes into a longitudinal trench running the entire length of the dock in the center. Electric motors operate the pumps and are set in the upper compartments of the lateral caissons being connected to the pumps by vertical shafts.

The total volume of concrete used in the dock approximated 575 cu.m. This volume corresponded to a total thickness of concrete over the steel of 2.5 ft. The weight of the dock, including its machinery, is 1,700 tons. The dock is equipped with four three-ton cranes.

The impermeability of the concrete surface was effected merely by troweling over the entire surface with a cement mortar of a mixture of one part of cement to three of sand. This cement mortar was laid to a thickness of 15 mm.

Material contained in this article was taken from a recent issue of *Le Genie Civil*.

The Value of Geodetic Control in City Survey Work

One Triangulation Should Serve Most Exacting Demands—Accuracy and Permanence Invaluable—Survey Standards That Should Be Maintained

By Hugh C. Mitchell
Mathematician, Division of Geodesy, U. S. Coast and Geodetic Survey, Washington, D. C.

RESULTS of a questionnaire circulated some months ago among city engineers by the U. S. Coast and Geodetic Survey indciate that few engineers are using either geodetic methods or control in city survey work. Total replies to the questionnaire numbered 216. Twenty engineers stated that they were using geodetic methods and twenty-four that they were using geodetic control. The control used consisted usually of precise-level bench marks established by one of the federal surveys. A few engineers had made use of precise triangulation control.

An appreciation of the accuracy attained through the use of geodetic methods and control elicited from several engineers strong endorsements of its use, and from' others came simply expressions of a need for more accurate and standard methods in making city surveys.

The need for greater permanency in the engineering personnel was indicated in a number of ways by the replies from various engineers. Rapidly-shifting personnel is a strong argument for standardization of survey methods. If surveys were standardized, how easily the incoming engineer could take hold of his work, and how great would be the saving to the taxpayer, both through having full and efficient service on the part of an important public official and through the possession of accurate data for its engineering and surety work.

In one town, having a population of some 16,000, the questionnaire was delivered to the chairman of the committee on streets who returned it with the note that "we do not employ an engineer regularly. This was delivered at my house and of course is nearly all latin to me but nevertheless deserves acknowledgment." It will be a busy engineer who eventually takes up the work of a city which has attained the size of this one and has no definite engineering service.

Two general conclusions may be drawn from the great variety of answers received to the questionnaire. One is that there exist now no exact and adequate standards of accuracy in city survey work, and the other is the emphatic need of such standards. It is the belief of the writer that through standardization of instruments and utilization of geodetic methods and control will come accuracy and economy, not only in city but in all survey work.

Realization of the need for accurate control for city work will doubtless lead the engineer to ask: "Of what use to me are geodetic methods and control? What constitutes acceptable geodetic control? How am I to obtain it?

While geodetic control may be used for cadastral, topographic and underground surveys, as well as for other surveys of special character, its value is greatest where greatest accuracy is required. In most cities this is probably in connection with cadastral surveys. For a small scale topographic survey of a city or even for a large-scale map of a small area, the ordinary methods of plane surveying will usually prove sufficiently accurate. But as the area is extended and the accuracy required is increased more precise methods are demanded, until finally the methods and formulas of geodetic surveying are required. Slowly the larger cities of our country are coming to realize this fact, but it is proving a difficult matter to get away from the old rule of letting the immediate purpose of the survey determine the accuracy required. But why make a rough survey of a region, when in a few days or a few months a precise survey, needed for some other purpose, will be made? Why not make the complete and precise survey in the first place and use it for all purposes? If reasons why this is not feasible exist, why not at least execute the control, and make it of such character as will serve *all* surveys? If triangulation is executed of sufficient accuracy to serve as control for cadastral surveys it will generally be suitable as control for all surveys. The character of the instruments needed for precise triangulation, the unique professional training required for its execution as well as for least-squares adjustment, without which final results may not be had: *all* dictate that but *one triangulation of a city should be made*, and that should be of an accuracy which will serve the most exacting demands.

The value of geodetic methods and control in city survey work may be grouped under two general heads: *Accuracy* and *permanency* of results.

Accuracy—The triangulation of Greater New York (1903-8) had an accuracy of 1 part in 25,000 for length of line. This was the accuracy sought; had a greater accuracy been desired at that time, it could probably have been obtained. Subsequent triangulation work has shown that greater accuracy should have been sought. The methods of triangulation surveying have now been so standardized that it is possible to obtain any reasonable specified accuracy. Traverse may be run with nearly the same linear accuracy as the triangulation base line, but triangulation is required to control a traverse survey, to prevent an accumulation of errors in azimuth, which produce errors in position.

It is true also of the level survey that where accuracy is required in the survey over a large area, the use of geodetic instruments and methods will prevent the accumulation of errors which ordinary methods might permit.

Permanency—There is but *one* point at the intersection of any given parallel and any given meridian on a specified datum. A survey point, if determined on a standard geodetic datum, has as witness marks all the other survey points whose positions are known on that datum. Thus in the case of the triangulations of Cincinnati and of New York City, both of which are connected directly to the great triangulation net of the United States, each point in the city survey has as

witness marks—the 20,000-odd triangulation stations of that net.

A small charge of dynamite or an ill-considered excavation may destroy a monument but the point it occupied can readily be re-determined from other triangulation stations of the same system. It may interest the engineer to look at a simple example of how destroyed stations are re-established. In the Coast and Geodetic Survey, where triangulation starts from an arc already in existence, it is the practice always to recover three stations of the older work, usually a triangle, and by re-observing the angles of this triangle, prove the recovery of the original stations. Three such stations, forming a triangle, were recovered some years ago at the junction of a new arc of precise triangulation with one which had been executed some four years earlier. Two of the angles of the triangle were re-measured with standard accuracy, the third was concluded. The triangle was solved using the new observations, and the results being compared with the original lengths of sides gave discrepancies which amounted in proportional parts to 1 in 434,000 and 1 in 868,000.

Standards for the Survey—As a rule no general survey calls for greater accuracy than does the cadastral survey, which requires an accuracy which should be a function of the future reasonable value of the property surveyed. If geodetic control is executed which will serve the needs of the cadastral survey, the control demands of all surveys will be met. In New York City an accuracy in triangulation approaching 1 part in 100,000 is now believed desirable. Cities of the second class would probably require triangulation of an accuracy around 1 part in 50,000, while other cities for which a geodetic survey might be proposed would find 1 part in 25,000 satisfactory.

Specifications for the Survey—The triangulation should be controlled by at least two base lines: a line brought in from the triangulation net of the country, and a measured line. These two lines should be so situated as to include the major portion of the triangulation between them. It should be possible to compute any line of the triangulation from at least two bases, thus making it possible to determine its accuracy. The bases measured should have an accuracy of at least 1 part in 500,000. This accuracy can be obtained by ordinary base line methods, using *invar* tapes, which must be standardized immediately before and after the measurement of the base line or lines. The tapes must be used on the base in exactly the same manner as they were used in the standardization; that is, same tension, number of supports, etc. A base line can be measured with the required accuracy on any grade up to 10 per cent, and a small creek or gulley, if less than one tape length (50 meters) in width will offer no obstacle to the measurement.

An angle may be introduced into a measured base line if proper care is had in measuring the angle. Offsets are sometimes required; they should be measured from *one* line projected through for the entire length of the base. It seldom will be feasible to occupy with a theodolite the ends of the measured line, but signals must be placed close by for that purpose. If the measured line and the line connecting the triangulation signals are made sides of a very flat quadrilateral in which all the angles are measured, the transfer of length will be made with no appreciable loss of accuracy. Lengths should be carried ahead through overlapping quadrilaterals.

Accuracy of Triangulation—The accuracy of the triangulation is determined by three main factors: the frequency and accuracy of the base lines; the shape of the figures through which the lengths are carried; and the quality of the observations of horizontal angles. The shape of the figures will determine where bases should be inserted to maintain a desired accuracy.

For an accuracy of 1 part in 25,000, which is the minimum standard for the precise triangulation of the federal survey, the angles are measured with 16 positions of a direction instrument reading to one or two seconds, or if a repeating theodolite of proper size is used (10-in. circle read by verniers 3 sec. to 5 sec. of arc), then five sets are taken on each angle. A set consists of six measures of the angle with the telescope direct, and six of its explement, telescope reversed. The only condition introduced is that the horizon be closed.

Triangulation of this accuracy exceeds the requirements for the control of a topographic survey on a scale of 200 ft. to the inch, a scale which is considered desirable for general city planning. On an underground survey, if mapped 40 ft. to the inch, the plotting unit of one-eightieth inch represents ½ ft. on the ground, and if the triangulation stations are two miles apart, the possible error in that distance will be 0.4 ft. or 0.01 in. on scale.

For the topographic survey the traverse need be only of an accuracy and a frequency which the scale of the map dictates, though even for traverse it may be found economical to execute only the most accurate type and use it for all dependent surveys. If this can not be done the topographic map will require traverses every half mile, with stations placed every 1,000 ft., and an accuracy of 1 part in 5,000 to 10,000.

The cadastral survey requires traverse of the same accuracy as the triangulation and should determine stations at every street intersection. The cadastral marks should be placed within the protection of the curb, in such position as to be reasonably safe from destruction in the construction of buildings or of streets. Since the traverse stations are to be considered temporary, the cadastral points must be susceptible of occupation with an instrument and contiguous ones must be intervisible.

Least-Squares Adjustment—In computing the triangulation it must be remembered that while values for lengths and angles may be obtained which will satisfy the demands of such surveys as the topographic, the most probable values for those quantities and the ones which are to be considered final can be obtained only *through a least-squares adjustment*. In a cadastral survey this is a most essential operation.

Marking Stations—While a triangulation station, if destroyed, can be replaced, one must not overlook the fact that such replacement is necessarily an expensive operation, and the station should therefore be preserved, as far as can economically be done, by physical marks. A sufficient number of stations should be established in open ground to render it unnecessary to carry a new triangulation more than two or three triangles to replace lost stations. The ground mark for such a station should be monumental in character, and the ground it occupies should be owned in fee by the city.

Precise Levels—The precise levels can best be run using the type of level which two decades of use in the U. S. Coast and Geodetic Survey have proved most satisfactory. Its essential qualities are: (1) That the observer is able to hold the bubble in the middle of its tube while he reads three lines of the diaphragm as seen projected against the level rod; (2) constancy of temperature conditions in the instrument through the use of invar; (3) control over the adjustment; and (4) the determination of the collimation error. Invar, which has a very small coefficient of expansion, is also used for rod faces. The use of a target in leveling is to be avoided, except where the width of a river crossing makes one necessary. Even where a wye level is used, the writer believes that the use of self-reading rods of standardized length, equalizing the lengths of foresights and backsights as each station, and the reading of three wires on the rod, will tend to give both increased speed and accuracy.

Bench Marks—A splendid arrangement of bench marks is to place them in pairs, as was done in the survey of Cincinnati. The two marks of a pair should be placed close enough together to be connected in one or two set-ups of the level instrument, yet so placed as not to be subject to the same destroying agencies. Where marks are placed on buildings, only such buildings as are apt to remain a long time, and such parts of those buildings as will not be affected by ordinary remodeling, should be used. Ground marks should be protected against traffic, vandalism and frost.

The criterion for precise levels is an agreement between two runnings over a section between bench marks on 4 mm. times the square root of the length of the section in kilometers (or 0.017 feet times the square root of the length of the section in miles). The two runnings of a section are made in different directions and on different days.

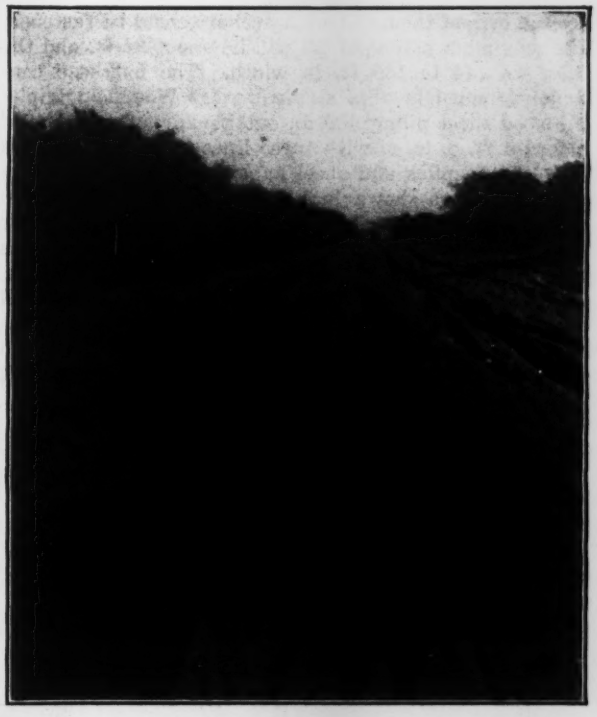
Advisory Committee on Treasury Water Standards

An advisory committee on official standards for water supplies on railway trains and on vessels engaged in interstate commerce has been created by the Public Health Service and is announced in detail in *Public Health Reports* for June 16, 1922. The function of the committee is "to review the present Treasury Department's standard for drinking water on interstate common carriers and to recommend a standard, or standards, based on recommended specific methods of laboratory analysis and field surveys, which will be applicable to all classes of water supplies coming within the supervision of the interstate quarantine regulations of the United States." The committee numbers 42 members, including Dr. A. J. McLaughlin, assistant surgeon-general as chairman, and five others connected with the United States Public Health Service, among which are two associate sanitary engineers. The Department of Agriculture, Commerce, Interior, Navy, and War each has a representative on the committee. Eleven scientific associations are represented by one member each. These include the American Society of Civil Engineers, American Public Health Association, American Water Works Association, American Chemical Society, and the Society of American Bacteriologists, and there are nineteen "sanitarians" on the committee. Among these are some of the most noted engineers, chemists, and bacteriologists in the country, including men in private practice.

Proposed Road on Mexican Border Would Involve Treaty

"In the southeast corner of California a chain of sand-hills 50 miles long and 7 miles wide constitutes a barrier to the construction of an adequate interstate highway connecting El Centro and Yuma, Ariz.," according to a bulletin issued by the California highway commission. "The hills are constantly on the move and during one of the high winds which are prevalent at certain seasons of the year would bury past economical reclamation any permanent type of paved highway. At the present time the sand-hills are bridged by a plank road built in sections which can be moved or abandoned to accommodate the drift of the sand." The construction of this road was described in *Engineering News-Record*, July 29, 1916, p. 131.

With the co-operation of Mexican officials from Lower California, the bulletin continues, the California commission made a reconnoissance survey and found that the sand-hills end a short distance south of the international line and that the drift is all northward, so that



A ROAD THROUGH THE SILT OF THE COLORADO VALLEY

a road located on the Mexican side for about 14 miles would entirely escape the sand menace. Before such a road could be built, an international treaty would have to be negotiated and arrangement would also have to be made for special financing as funds now available could not be expended outside the state boundaries. State legal authorities have advised the highway commission however, that funds for the construction of a 14-mile section of highway through Mexican territory could be had by special act of the state legislature and that motor vehicle department funds could be used for the maintenance of such a highway providing treaty arrangements are made with Mexico neutralizing the highway zone and vesting the control of the highway

construction and maintenance in the California highway commission. Mexican officials are believed to be friendly to the plan.

As an example of the kind of country through which such a road must go the accompanying view is given. This was taken last year by a member of the staff of *Engineering News-Record* in Mexico, about ten miles south of the line at Calexico and is remembered by him as the worst piece of road on the continent.

Anchored Bulkheads Across Slips on Chicago River

Fill in Large Slips To Be Retained by Bulkheads in Deep Water at Dock Line and Tied to Pile-Bent Anchorage

IN PREPARING to fill several old slips opening from the Chicago River and Lake Michigan the Illinois Central R.R. was faced with the necessity of providing some form of anchorage for the bulkheads which will close the mouths of the slips, since there is no solid ground behind them to which anchors could be fastened. The maximum height of fill will be about 32 ft. and the slips are 144 to 186 ft. in width. The bulkhead construction consists of a single line of Wakefield triple-lap wood sheet piling and an outside row of round piles spaced 4 ft. c. to c., with three lines of waling timbers between the piles and sheeting and two on the outside of the piles, as shown in Fig. 1.

Across each slip will be placed two rows of piles for the anchorage, with anchor timbers behind the piles and with an inclined brace pile to each vertical pile, as shown. The head of each pile in the first row will be tied to the foot of the corresponding pile in the second row by a 1⅜-in. loop-end rod. The upper end of this rod will be attached to a stirrup or yoke around

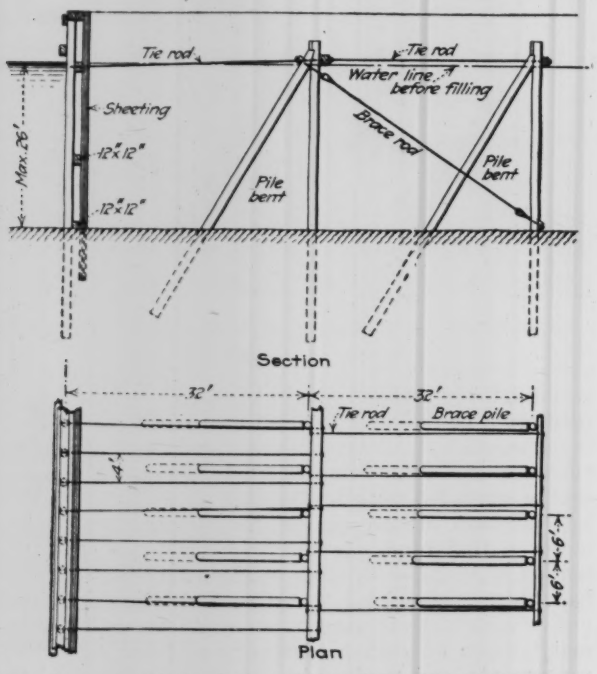


FIG. 1. BRACED PILE ANCHORAGE FOR BULKHEADS

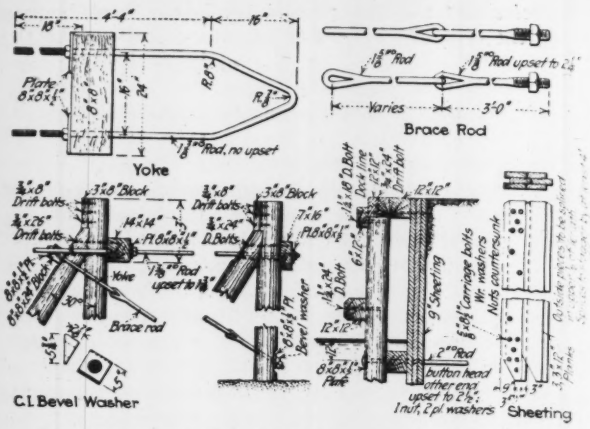


FIG. 2. DETAILS OF PILE BENT ANCHORAGE

the heads of both vertical and brace piles and the lower end will be attached to a threaded rod passed through the rear pile. The minimum penetration is to be 15 ft. for vertical piles and 20 ft. for brace piles. Details of construction are shown in Fig. 2.

Through each bulkhead pile will extend a 2-in. tie-rod with a button-head and bearing on a ½-in. plate 8 x 8 in. The rear end of the rod will be held by a nut and washer at the back of the waling timber on the first row of anchor piles. Other tie-rods, 1⅜-in. in diameter, with both ends threaded, will connect the two rows of braced piles. In order to prevent undue pressure, the filling for a distance of 60 ft. back from the face of the bulkhead will be made of stable material. This will also enable the anchor bents to be relied upon as deadmen embedded in the fill. No cinders or lime are to be used within 175 ft. of the bulkhead, as these materials might result in excessively rapid corrosion of the steel rods.

It is estimated that this bulkhead will cost considerably less than the usual construction consisting of a double row of piles with rock filling between them. Further, since it is probable that the railway company will erect buildings along the water front, the rock filling of such a bulkhead would interfere with future foundation work. This filling of the slips is a preliminary step in the large scheme of railway terminal development at Chicago by the Illinois Central R.R. The bulkhead design was prepared by C. H. Mottier, office engineer, under the direction of D. J. Brumley, chief engineer of Chicago terminal improvements, Illinois Central R.R.

Limitations of Land Drainage by Wells

Land drainage by wells driven through impermeable strata to porous soil or open rock, as practiced to some extent in the central states and in Florida, is of limited efficiency and relatively high cost, according to a statement of the U. S. Bureau of Public Roads. Of 73 wells investigated in the north-central states 42 were considered unsatisfactory, 23 of doubtful value and only eight satisfactory. Of wells carefully located and driven to porous limestone about 75 per cent have proved successful. The cost of drainage by wells has ranged from $90 to $200 per acre drained, indicating the average for outlets in organized drainage districts.

Return-Flow Water From Irrigation Developments

About 50 per Cent of Water Diverted Is Source of Return Flow—Statistics of Colorado Valleys Indicate 1 Acre-Foot per Acre Recoverable, Maximum in Summer and Fall

By R. I. Meeker
Irrigation Engineer, Denver, Colo.

SINCE a surprisingly small amount of water is consumed or needed compared with the quantities diverted, any salvage or return that can be made extends by that much valuable contiguous territory. The increasing volume of return flow or seepage water from irrigation, the growing importance of such waters in an economic way, their relation to volumes diverted and acreage irrigated and the dearth of recent data in current engineering literature have prompted this article. It is hoped that its publication will induce the compilation and publication by engineers of facts and a discussion of similar data coming under their observation in other irrigated areas. Advances of a 10-year period in irrigation history and the engineering world generally are so great that there is a lag between accomplishment and the dissemination of recorded progress.

Application of water to land in the arid states has wrought wide changes in river flow in the irrigated areas. It is common history in the older irrigated valleys that natural stream flow, after heavy depletion or reduction by canal diversions for irrigation, increases in volume through the irrigated areas; also that dry tributary channels frequently become live streams and low-lying areas waterlogged and swampy. The explanation is summed up in four words "return water from irrigation." Further tangible evidence of increase is found in a constantly enlarged acreage watered under old ditches and from junior ditches, whose water supply was considered precarious or "flood right" in character at the time of construction.

Attention is directed to general changes in stream flow due to the settlement of the arid West. Such changes are a matter of common observation among the older residents, and while precise data of flow variation may not be cited, the attendant effects are evident and form a crude measure of the tendencies resulting from artificial causes.

Before the advent of western civilization, as recently as 1860, stream flow in the West was regulated to some extent (excluding seasonal variation) by natural conditions of an excellent forest cover in the mountainous area and a heavy grass carpet in both mountain and plain areas. While spring floods occurred from melting snows and other floods from summer rains, their peak variations and erosive effects were undoubtedly much less than at present. The natural and profuse carpet of vegetation retarded run-off, increased absorption in transit and delayed immediate appearance in main river channels. Over-grazing of the grass cover in plain, plateau and mountain areas is placed first in importance as a cause of the change in stream flow and erosion, with forest denudation by axe and fire second. Two phases of irrigation offset these destructive tendencies; (1) reduced flood flows from canal diversions and reservoir impounding, and (2) return flow from underground soil reservoirs of the irrigated areas. The general net result to the lower portions of river basins where irrigation is extensive is a better equalized river and reduced flood flows. The streams of the more arid Southwest are generally exceptions to the above statement because irrigated areas are small and reservoir capacity negligible. On such streams peak or flood flows are more acute and more frequent than formerly.

Economic Value—Irrigation history is replete with optimism of human nature as expressed in the construction of ditches whose available water supply was doubtful in character or undetermined. Early prediction was that such ditches would have a poor water supply, an increasingly inferior water supply, or ultimately no water supply. The compensation effect of return flow has saved many a wild or ill-advised effort in ditch construction from failure and turned it to success. The extension of the irrigated area and its depth of penetration into the surrounding arid land has been the surprise of pioneer engineers, and the results have exceeded the anticipation of the most sanguine residents in several irrigated valleys. Several communities whose former water status was uncertain and precarious have become prosperous and their water rights are now rated first class. Seepage water has been a big factor in the development of the South Platte Valley. Perhaps no area is more typical or better illustrative of the beneficial and healing effects of return waters from irrigation than the lower South Platte River area in Colorado between the towns of Fort Morgan and Julesburg, a distance of 100 miles. The present assessed valuation of the irrigated land of the lower South Platte Valley is over $10,000,000, the area irrigated being 180,000 acres. The average return flow of the river section is 500 sec.-ft. or 360,000 acre-ft. annually. Without seepage water this area would have only a flood-water supply and its economic importance would shrink at least one-half or probably from $40,000,000 to $20,000,000.

Seepage or return waters have attained such volume on the U. S. Reclamation Service projects that the Federal Government now makes specific claim for such waters on the various projects. On the North Platte Project in Wyoming and Nebraska, the Shoshone Project in Wyoming, and others, the volume and value of such waters is so great that litigation has resulted.

Source of Return Flow—In the process of conveying water to land in unlined canals and its application to crop production there are excessive losses. Roughly they may be tabulated as follows:

	Range %	Average %
Conveyance or seepage losses by deep percolation from unlined canals and laterals	20–50	35*
Field losses by deep percolation and surface waste in application	10–20	15
Evaporation losses from canal water, saturated ground surfaces and irrigated fields	10–30	20
Plant evaporation or transpiration (actual water consumption)	20–40	30

* Mean of 21 U. S. Reclamation Service projects, 7 years' record, 1912 to 1919, inclusive.

From the foregoing table it is evident that the plant consumption of water is, roughly, only from one-fifth to one-third of the water diverted at the river headgate; also it is evident that (excluding lined canals)

deep percolation losses in canal, lateral and field, amount to 50 per cent of the water diverted. Probably 50 per cent is a general figure for large areas and varied conditions. Where water is scarce and application is made with good husbandry these figures are reduced, and where water is plentiful and used lavishly they should be increased. It should also be understood that soil texture is a large factor in changing the above-mentioned percentage. It is, therefore, evident that 50 per cent or more of the water diverted at the river is available as a source to return flow.

Underground Soil Reservoirs—Ordinary soil is porous, the voids ranging from 30 to 40 per cent. Each acre of saturated soil in irrigated areas will, therefore, reservoir 1 acre-ft. of underground water for each 3 ft. of depth. Unfilled underground soil reservoirs explain the heavy water consumption which occurs when irrigating new land and account for the lagging effect of return-flow waters. The magnitude of such underground reservoirs is illustrated by the Cache la Poudre in Colorado where 250,000 acres are irrigated.

Assuming the average soil depth to bedrock (shale, sandstone and marls) to be 20 ft. and the average depth to the water table to be 5 ft., there is a soil depth 7.5 ft. for underground water storage. Using a pore space of one-third, then 1 acre of surface soil would cover 5 acre-ft. of underground storage. In an area of 250,000 acres the underground reservoir would contain 1,250,000 acre-ft. The actual underground soil reservoir is more extensive because unirrigated areas lie within and adjacent to the boundaries of the irrigated tract. This means that during the 50 years of irrigation history in that valley there has been a gradual withdrawal of at least 1,500,000 acre-ft. of water from river circulation. This vast underground reservoir naturally fluctuates slightly from year to year, and in dry cycles is depleted, serving as an equalizer to river flow, but recovering during years of heavy stream flow and application.

When irrigation is first practiced in a community the water demand (per acre irrigated) on river supply is at a maximum, and practically all water diverted, except surface waste, is temporarily lost to the stream. Gradually there is a building up of an underground reservoir in from 5 to 20 years with return flow in increasing volume until eventually the return flow may approximate or exceed one-third of the total yearly diversion. It is apparent that during the irrigation history of a river there occurs a period of years when irrigation demands indicate that the limit of water supply has been reached. This condition is only temporary and later on return flow enriches river flow and permits an extension of the irrigated acreage.

Investigations on the Poudre River in Colorado show a return of close to 35 per cent of the annual average original water supply of that stream measured at entry to the plains. On the South Platte in Colorado the percentage is about 50. On the Salt and Gila Rivers in Arizona returns of 35 to 65 per cent have been measured.

History of Return Flow—Return waters from irrigation were first observed in Colorado 40 years ago, irrigation having commenced in a small way in 1860. The first known published return-flow measurements were made in 1885 on the Cache la Poudre River in Colorado between Fort Collins and Greeley. They confirmed the observations of irrigators for several years to the effect that there was an increase in river flow. Commencing in 1889 and continuing until 1915, covering a period of 32 years, seepage measurements were made annually on the Cache la Poudre River from Poudre Canyon to the mouth, 47 miles, and on the South Platte River from Platte Canyon to the Nebraska line, a distance of 235 miles. During that period seepage or return flow measurements were also extended to the important streams in the principal irrigated valleys in Colorado. Other states have conducted similar investigations. In Arizona early return-flow measurements were made on the Salt River and the Gila (see U. S. Department of Agriculture Experiment Station Bulletin 104), and in 1910 amounted to 200,000 acre-ft. During the past five years the U. S. Reclamation Service has made special investigations on some of the modern irrigation projects in connection with drainage return flow from irrigation. The conclusion from these studies and from comparisons with the natural return flow from large older irrigated areas is that the amount of water actually consumed by crops is relatively small compared with the amount diverted, and further that with efficient drainage on an irrigated project, the actual plant consumption has decidedly low limits regardless of the water applied.

Method of Measurements—The first return-flow measurements were determined by dividing a river into sections 5, 10 or 20 miles in length and measuring with current meters the section inflow (in sec.-ft.); section outflow and all intervening tributary inflows and ditch or canal diversions; the total inflow minus the total outflow gives the gain or loss. The work was conducted more as a determination of river gains or losses than total return flow of a specific irrigated area. Where pronounced returns were observed in side channels the work was extended to them. Work has usually been confined to main stream channels.

Such investigations were formerly conducted in the late summer or fall when stream flow was low or at a minimum and river measurements could be made by wading. September and October were the usual months although a few measurements have been made in the spring; rainfall was meager in the fall months, and conditions generally were more favorable to accuracy. At first it was assumed that seepage returns were more or less constant throughout the year, and the fall records were frequently taken at face value for the year. In recent years investigations on the main South Platte River by the state engineer of Colorado were made during every month of the year to determine seasonal variations and their character. More refined methods were used and greater accuracy secured than during the pioneer investigations. In 1919-20 on a 150-mile stretch of the main South Platte River continuous records by automatic water-stage registers were secured for 18 months of all section inflow, section outflow, tributary inflow and canal diversions. Some 50 recording gages were required. The seasonal variation is comparatively small and approximates the variations found in the North Platte in Nebraska where soil conditions are similar (viz., a porous, sandy soil and fair natural drainage). May appears to be the month of the minimum return, 6.5 per cent, with September the month of maximum return, 10 per cent, July having the average of 8.5 per cent of the total for the year.

It should be remembered that the return-flow investigations mentioned were usually confined to main streams and main tributaries, that return flow is frequently diverted and intercepted before it reaches the main streams; hence, the recorded data may be considered as being less than the actual return of a given area. On the other hand the measurements made in the fall months, especially on the South Platte, would show, if applied for the year period, higher results than the actual average, or a difference of about 10 per cent too much.

TABLE I—RÉSUMÉ OF FACTORS AFFECTING RETURN FLOW IN CACHE LA POUDRE AND SOUTH PLATTE RIVERS

Item	Cache la Poudre	South Platte
Flow, average annual, mouth canyon	375,000 acre-ft.; 36 years' record	1,700,000 acre-ft.
Elevation irrigated area	5,500 to 4,600 ft.	5,700 to 3,500 ft.
Temperature, mean annual	47 deg. Fahr.	49 deg. Fahr.
Rainfall, mean annual	15 in. 38-yr. record	15 in.
Rainfall in growing season, Apr.-Oct.	7.5 in.	7.5 in.
Growing season, between frosts	150 days	155 days
Acreage irrigated, 1920	250,000	1,000,000
Years since first irrigated	50	60
Total reservoir capacity	160,000 acre-ft	1,000,000 acre-ft.
Diversion duty per acre per year	1 to 2 acre-ft.	2± acre-ft.
Consumption use per acre per year	1.25± acre-ft.	1.25± acre-ft.
Return flow, annual	130,000 acre-ft.	1,000,000 acre-ft.
Water table	Stable	Approaching equilibrium
Soil conditions	Sandy loam and clay loam in small areas	Sandy loam
Nature of river channel	Narrow and rocky	Wide, sandy, shallow below Denver.

Summary of Tables—Table I gives general data for two areas where return waters are important factors of irrigation. In both the chief crops are alfalfa, sugar beets, grain and potatoes. The Cache la Poudre flow includes 35,000 acre-ft. trans-mountain diversions but the Platte flow is corrected for storage and trans-mountain water.

Tables II and III indicate the growth of return water covering a period of over 30 years as measured in the river channels.

Table IV gives monthly per cents of annual return both on river sections and drainage systems.

Table V gives general information and comparative data on the volume of return flow.

TABLE II. RETURN FLOW FROM CACHE LA POUDRE VALLEY
Section length 47 miles, canyon mouth to junction with South Platte

Year	Sec.-Ft.	Acre-Ft. Per Year *	Acres Irrigated
1870	0	0	4,500
1880	48	35,000	10,000
1890	101	73,000	108,000
1900	110	80,060	160,000
1910	160	116,000	207,000
1915	175	126,000	246,000
1920	...	(est.) 130,000	250,000

* These values approximate only.

Tables II and III are based on actual return-flow measurements of the U. S. Division of Irrigation Investigations, Colorado Agricultural College, and the State Engineer's Office of Colorado. There is a slight seasonal variation. The actual return flow of the entire irrigated area is greater because these data do not include tributary streams where ditches frequently intercept and divert return waters before they reach the parent stream.

The South Platte records are for 1920 and were continuous for a 12-months period with automatic water registers. The return during the irrigation season was 60 per cent.

The North Platte figures are a mean of three years, 1915, 1916 and 1917 and the return during the irrigation season was 59 per cent.

The Carmel record is a means of 6 years' discharge measurements at 2- to 3-week intervals from 1915 to 1920 inclusive. The return was 60 per cent during the irrigation season. A small amount of drain water was used within the district and is not included. The average annual return per acre was 1.2 acre-ft. From Jan. 1, 1915, to May 31, 1916, the measurements were made by the office of Public Roads and Rural Engineering, U. S. Department of Agriculture. From then to Dec. 31, 1920, the work was carried on by the State Engineer's Office every three weeks with daily flows interpolated on account of the regularity.

The Rio Grande record is for the year 1920. Of the total, 58 per cent of the return is in the irrigation season. Monthly measurements were made by the State Engineer's Office and gage heights taken by the Rio Grande Drainage District except during the winter, when interpolations were made from the discharge measurements.

Between Whalen, Wyo., and Bridgeport, Neb., return waters from irrigation are pronounced, and especially on the Interstate Unit of the North Platte Project of the U. S. Reclamation Service where considerable artificial drainage has been necessary to avoid water-logging.

In 1918 visible return flow from the Interstate Canal and lands irrigated from it measured in open drain at their intersection with the Tri-State Canal amounted to 150,000 acre-ft. annually from 100,000 acres of irrigated land, or 1.5 acre-ft. per acre per year.

TABLE III. RETURN FLOW FROM SOUTH PLATTE VALLEY
Section length 235 miles, Platte Canyon to Julesburg, Nebraska line

Year	Sec.-ft.	Approx. Acre-ft. Per Year	Acres Irrigated	Authority
1889	*451	326,000	421,000	Census
1899	1,026	742,000	710,000	Census
1904	1,038	750,000	685,000	1902 Census
1908	1,197	865,000	832,000	State Engineer
1913	1,129	816,000	958,000	State Engineer
1920	1,400	1,000,000	1,100,000	Census

* To Iliff only.

NOTE: Measurements made in fall months except 1920 data, which are based on 12-month period with automatic registers; fall measurements applied, as yearly returns give results 10 to 15 per cent too high.

In 1918 and 1920 the return waters to the North Platte River in a 125-mile section between Whalen and Bridgeport amounted to 400,000 acre-ft. annually. The soil on the north side of the river where 75 per cent of the irrigated area lies is very sandy and porous; on the south side the soil is from a sandy loam to a clayey loam.

Progressive Increase—As to the increase in the return flow over a period of years, data from published records of the State Engineer's Office and the Colorado Agricultural College are as follows: The 235-mile stretch of the South Platte from Platte Canyon to the Nebraska line increased in return flow in the 20-year period from 1900 to 1920 from 914 sec.-ft. to 1,400 sec.-ft. Similarly in 47 miles of the Poudre from the canyon to the mouth from 1900 to 1915 the increase was from 110 sec.-ft. to 175 sec.-ft. The entire South Platte area, including both main tributaries from the foot of the mountains to the Colorado-Nebraska line from 1900 to 1910 increased from 1,201 sec.-ft. to 1,566 sec.-ft. The Arkansas River from Canyon City to the Colorado-Kansas line, 215 miles, in a 17-year period beginning in 1897 increased from 123 sec.-ft. to 547

TABLE IV. SEASONAL DRAINAGE RECOVERY OR RETURN FLOW FROM IRRIGATION

Stream or Project	Location	Acres	J	F	M	A	M	J	J	A	S	O	N	D
South Platte	70-mile lower section	90,000	7.0	7.5	7.5	7.5	6.5	8.0	8.5	9.5	10.0	9.5	9.5	8.5
North Platte	Interstate Unit—Wyo. and Neb.	100,000	7.0	6.7	7.6	6.6	6.8	6.4	7.0	9.0	11.5	11.6	11.0	9.6
Carmel Drainage District	San Luis Valley, Col.	5,700	4.0	4.0	5.0	6.0	9.0	14.0	16.0	12.0	9.0	9.0	7.0	5.0
Rio Grande Drainage Dist.	San Luis Valley, Col.	25,000	3.0	3.0	5.0	6.0	10.0	16.0	12.0	11.0	9.0	10.0	9.0	6.0

sec.-ft. The return flow in the Uncompahgre River from Bachelor to the mouth at Delta, 53 miles, in 1900 was 89 sec.-ft. and 21 years later had increased to 250 sec.-ft.

Return flow waters from irrigation along the Salt and Gila Rivers were well in evidence 15 to 20 years ago. Soil texture, slopes and narrow irrigated areas along the rivers combine to produce immediate and pronounced seepage water. In the Salt River Valley 30 per cent of return flow has been observed, and along the Upper Gila River 65 per cent. In 1900 260 sec.-ft. or about 190,000 acre-ft. annually were reported between Tempe and Gila Bend.

TABLE V. WATER RECOVERY FACTORS IN TWO DRAINAGE DISTRICTS IN THE RIO GRANDE VALLEY

Item	Carmel District	Rio Grande District
Area, acres	5,040	30,000
Area tributary to drains	5,700	.....
Location	13 mi. southeast Monte Vista	9 mi. northeast Monte Vista
Completed	1914	1920
Cost	$50,000	$200,000
Drain types	15 mi. outlet ditch; 8½ mi. rect. wood conduits, 7 ft. below surface. ¼ mile apart; 10½ mi. tile.	13.1 mi. outlet ditch; 2.1 mi. covered outlet; 39.4 mi. rect. wood-conduit, laterals 1 mi. apart, 5 to 7 ft. below surface.
Character of soil	Top 24-in. sandy loam; subsoil, gravel	Top 15 to 30 in. sandy loam; subsoil coarse sand and gravel.
Elevation	7,600 ft.	7,600 ft.
Annual rainfall	8 in.	8 in.
Irrigation season	150 days	150 days
Irrigation methods	Surface in furrows	*Surface and sub-irrigation

* An alternate system of irrigation and drainage is practiced. Concrete checks with gates are located in the drainage laterals. The water table is controlled to give the effect of sub-irrigation.

Drainage Recovery—Drainage has become an important problem to most irrigation projects. In 1920 the U. S. Reclamation Service expended $996,000 on drainage in connection with its various 21 projects (see *Reclamation Record*, March, 1921, page 101).

The San Luis Valley lies on the headwaters of the Rio Grande in Southern Colorado. The Valley is an old lake bed and is consequently very flat, and has poor natural drainage. Large areas have become waterlogged and alkalied, both irrigated and unirrigated. Approximately 500,000 acres of raw and irrigated land need drainage relief in some form. Drainage districts have been organized and constructed. The following data will be of value. For the Carmel Districts there is a return of 1.2 acre-ft. per acre drained (6-year record). The duty is roughly 2 acre-ft. per acre. In the Rio Grande District just completed the return is close to 1 acre-ft. per acre drained. It should be noted that sub-soil conditions are favorable to drainage and in ordinary years is used freely.

Summary—The following paragraphs summarize the conclusions of this study:

1. Ordinarily 50 per cent of the water diverted for irrigation purposes becomes a source of return flow.

2. Annual return flows of from 35 to 65 per cent of the river flow diverted have been measured for large compact irrigated areas.

3. In the South Platte and tributary valleys in Colorado, where 1,100,000 acres are irrigated, return flow amounts to 1,000,000 acre-ft. annually.

4. In the Cache la Poudre Valley where irrigation is intensive and 250,000 acres are irrigated, the annual return flow is 130,000 acre-ft. or about 0.50 acre-ft. per acre.

5. In the North Platte Valley, Nebraska, where water is plentiful, the annual returns from 250,000 acres are 1.6 acre-ft. per acre.

6. Annual drainage returns on the two Colorado projects of 5,000 and 30,000 acres, respectively, fall close to 1 acre-ft. per acre.

7. Monthly returns throughout the year are not constant. The summer and fall months are the months of maximum return and the minimum returns occur in the winter and spring months.

8. From 50 to 60 per cent of return flow under natural or artificial drainage occurs during the irrigation season and is available for re-use.

9. Return-flow waters from irrigation in the older irrigated valleys are a large factor in water supply and have a large economic value.

Bibliography of Return Waters

Seepage or Return Water from Irrigation, by L. G. Carpenter, Bulletin 33, 1896, State Agricultural College, Fort Collins, Col.

Seepage and Return Waters, by L. G. Carpenter, Bulletin 180, 1916, parts 1, 2 and 3, Agricultural Experiment Station, Colorado Agricultural College, Fort Collins, Col.

Irrigation in Colorado, by C. W. Beach, Porter J. Preston, Bulletin 218, U. S. Department of Agriculture, Office of Experiment Stations, Washington, D. C.

Irrigation in Arizona, by R. H. Forbes, Bulletin 235, U. S. Department of Agriculture, Office of Experiment Stations, Washington, D. C.

State Engineer of Colorado, Biennial Reports, Tenth, Eleventh, Thirteenth, Fourteenth and Seventeenth.

Conveyance Losses of Water on U. S. Reclamation Service, Irrigation Projects, by E. A. Moritz, *Reclamation Record*, Vol. 12, No. 4, April, 1921, pp. 180-182.

Wayne County Plants 2,200 Trees

The Wayne County, Mich., Road Commission last week observed Arbor Day by planting 800 American elm, 950 Norway maple, 125 Oriental plane, 125 red oak, 100 pin oak, 50 paper birch, and 50 mountain ash trees—a total of 2,200. Ever since the adoption of the county road system in Wayne County, the Road Commission, according to Edward N. Hines, its chairman, has repeatedly urged that the treeless condition of the highways should be remedied. Until the special session of the legislature last year, at which time a law was passed making it possible to plant trees, nothing had been done.

In making this planting the matter of the future development of pavement width, of safety, as well as that of beauty, have all been taken into consideration. The trees are placed in rows 32 ft. from the center line of the pavement except in a few cases where they were planted to conform to trees already growing. This method of planting allows for a future widening of the pavement to 40 ft. and permits an additional 11 ft. for sidewalks and parking strip between pavement and trees. It gives a clear and safe view to auto drivers.

A survey of the entire county is being made, to provide a definite, systematic, continuing plan towards which to work as funds become available for roadside tree-planting and decoration and in time, Wayne County's 350 miles of concrete roads will not only be useful, but ornamental transportation mediums.

Some New Tests on Proportioning Mortar and Concrete

AT THE annual meeting of the American Society for Testing Materials at Atlantic City, June 27-30, two papers were presented giving experimental data on some recent investigations into the proportioning of mortars and concrete. The first, entitled "Relation Between Voids and Plasticity of Cement Mortars at Different Relative Water Content" was by Frank E. Richart and Edward E. Bauer, of the University of Illinois; the second, entitled "The Use of Excess Sand and Pit-Run Gravel in Concrete Pavements" by R. W. Crum of the Iowa State Highway Commission.

The paper by Prof. Richart and Mr. Bauer was in continuance of the study presented by Prof. A. N. Talbot, of the University of Illinois, at the meeting last year of the society (*Engineering News-Record*, July 28, 1921, p. 147); that is, the mortar-voids test is used in studying the plasticity of cement mortar. That paper gave quantitative information on the properties of various mortars, emphasized the relation between cement content, voids and strength, and described a laboratory method of determining the voids in any mortar mixture made with a given sand. The current paper studies mortars and concrete in the light of the mortar-voids theory and from the viewpoint of the laboratory. It establishes some principles regarding basic water content, relations between water content and consistency, and between strength and minimum voids.

The fundamental principles may be laid down as follows: (1) When a mixture of dry sand and cement is gaged with increasing amount of water there occurs a certain swelling or bulking of the mass such as is produced in sand alone when damped. (2) This is followed by a gradual decrease in the volume as the mixture develops cohesive properties until a point of minimum volume is reached where the mortar begins to become plastic. (3) With more water an increase in the volume is caused by the mechanical separation of the particles or dilution of the mixture by additional water. A certain definite amount of water is required to produce minimum voids and it appears that this amount of water may be used as a standard in determining the proper amount of mixing water for mortar used in test specimens. In any mortar or neat cement mixture the point of minimum voids is well defined, and it has been possible to duplicate its determination satisfactorily in repeated tests. Furthermore, the water producing minimum voids (termed in the paper the basic water content) appears to coincide quite closely with the water required by the standard Vicat test for plasticity.

Further tests showed that the water required for maximum strength and for minimum voids is in general about the same, while in some cases the maximum strength was obtained with 105 to 110 per cent of the basic water content.

A possible use of the test is in establishing uniform plasticity for mortars under test. Standards today do not give a very good basis to measure this plasticity and workability, but the authors state that from their tests it seems possible that the basic water content or some proportion thereof might be used as a standard water content for comparative tests of the strength of mortar. For a single mortar mixture the basic water content may be determined in a few minutes and values may be obtained for all probable mortar mixes using a given sand.

As a deduction from the tests the authors conclude that it would be better to test mortar in a richer mix than the customary 1:3 proportion, say 1:2 for comparative test of sand, that being 1:2 by volume, though they suggest that possibly 1:2 by weight would be just as good. The tests also showed that the flow and slump tests appear to be fairly consistent with basic water content control.

Using Pit-Run Aggregate—Prof. Crum's paper is an extension of a paper on a similar subject presented at the 1919 annual meeting of the society, in which he proposed a method of proportioning concrete using pit-run aggregate with a high proportion of fine sand which is about all that can be economically procured in Iowa. Other qualities being equal, the principal objection to the use of pit-run gravel has been the fancied lack of uniformity in the resulting concrete. While Prof. Crum's experiments show that there is a great opportunity for improvement in the uniformity of concrete mixes, he notes that the mixtures of screened aggregates are no better in this respect than pit-run gravel mixtures and often not so good when the pit-run gravel is handled in the most advantageous manner. Acting on these and earlier tests, the Iowa State Highway Commission has based its standard specifications for single-course concrete pavement upon the assumption that it is possible to so design and construct concrete pavements of varying cement, sand, and coarse aggregate content (such as might occur in the natural deposit) that the result would be in as close agreement as may be expected from the arbitrary mixtures in common use. Furthermore, the more heavily sanded mixtures have at least two important advantages: (1) It is quite generally accepted that if the voids in the coarse aggregate are more than filled by the cement and sand mortar the internal grading of the coarse aggregate will have little effect upon the strength of the concrete. That being the case with the mixtures under discussion makes it possible to use certain aggregates which might not be suitable for use in the more common mixtures. (2) In proportioning mixtures of high sand—coarse aggregate ratio the amount of cement should be based upon the maximum amount of sand to be expected; then when the amount of sand at times becomes less, the high ratio of cement to sand will more than compensate for the variation. For instance, if the proportion be based upon 70 per cent of sand and the percentage of sand falls to 60, the mix would have more cement than the 60 per cent sand required and the variation would not be at the expense of the strength of the concrete. Mixes, such as the usual 1:2:4, which are intended to just fill the voids of the coarse aggregate do not provide any such factor of safety, and most of the variation is, therefore, more serious.

The department has established a table from which, given the percentage of sand in the pit-run aggregate by weight, the proportion by weight of cement to gravel and the approximate quantity of cement barrels per cubic yard is given both for pit-run gravel and screened gravel. Thus, for a sand in the aggregate running 34 to 40 per cent by weight with pit-run gravel the proportion by weight of cement to gravel would be 1:4.84 and with screened gravel, 1:1.93:2.91, and the approximate quantity of cement, 1.67 bbl. per cubic yard. The tests given by Prof. Crum in his latest paper show a fair uniformity of strength of field mixed concrete under this method of proportioning.

Concrete-Unit Roundhouses on the Pennsylvania R. R.

Large Buildings Framed of Precast Members—Walls of Brick and Steel Sash—Casting Yard and Unit Erection Methods

IN EXTENDING the large concrete roundhouse at the Pitcairn yard near Pittsburgh, Pa., the Pennsylvania R.R. has adopted a type of construction with precast structural units which was devised by the company's engineers in 1918 to facilitate the carrying out of a large program for the enlargement and improvement of engine terminals where the roundhouses were too small for modern locomotives. This unit construction has now been used for roundhouses at five or six

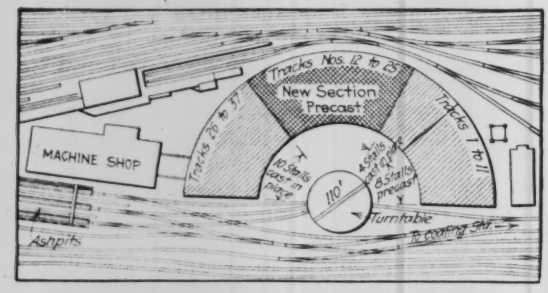


FIG. 1. CONCRETE ROUNDHOUSE AT PITCAIRN YARD

places on the eastern lines but the Pitcairn building is of particular interest since it includes both poured and precast concrete construction. It is notable also on account of its size, the segmental building covering an angle of 180 deg. and having 34 radial tracks or stalls diverging at an angle of 5 deg. 17 min. 38 sec. The building has an outside radius of 260 ft. 9 in. and a space of 85 ft. 9 in. between the inner wall and the 110-ft. turntable. The layout plan is shown in Fig. 1.

Plans for the Pitcairn roundhouse were adopted in 1918 and an 8-stall section of precast unit construction was then erected to form one end of the building. In 1918 a 10-stall section of poured concrete was built to form the opposite end, and in 1919 a 4-stall section of poured concrete was built adjacent to the first precast unit construction. The middle 12-stall section which will complete the structure is now to be built on the precast unit system. Poured concrete was used for the two intermediate sections for the reason that a supply of precast units was not available and it was desired to carry out the work as rapidly as possible owing to the large number of engines being handled at this point. The approximate cost per stall was $10,000 for the precast unit construction and $14,000 for the poured construction, but it must be remembered that the work was done during a period of maximum cost.

Concrete Framing—In cross-section the 120-ft. width of the building is divided into six 20-ft. bays by curved rows of columns, the longitudinal spacing of these columns being 13 ft. c. to c. in the inner wall and 28 ft. 8½ in. in the outer wall. Lines of ring girders are seated on brackets on the columns and have lugs on the ends to fit in recesses in the seats and thus lock the parts together. Lines of radial beams or roof joists laid across the girders are held in position by end lugs which are seated in the grooved top surfaces of the girders. On this concrete framing, which is made rigid by grouting the joints, is laid a 3½-in. roof slab of concrete poured in place or precast gypsum slabs. This roof slab is anchored by bolts or studs projecting from the roof joists and is covered with tar and slag roofing. The original design provided for unit slabs cast integrally with the joists, but these large slabs were unwieldy and their use was not continued.

From the cross-section, Fig. 2, it will be seen that the roof has a slope of about 1¼ in. per foot from the middle to each side and has a monitor roof over two bays. The columns under the sides of the monitor

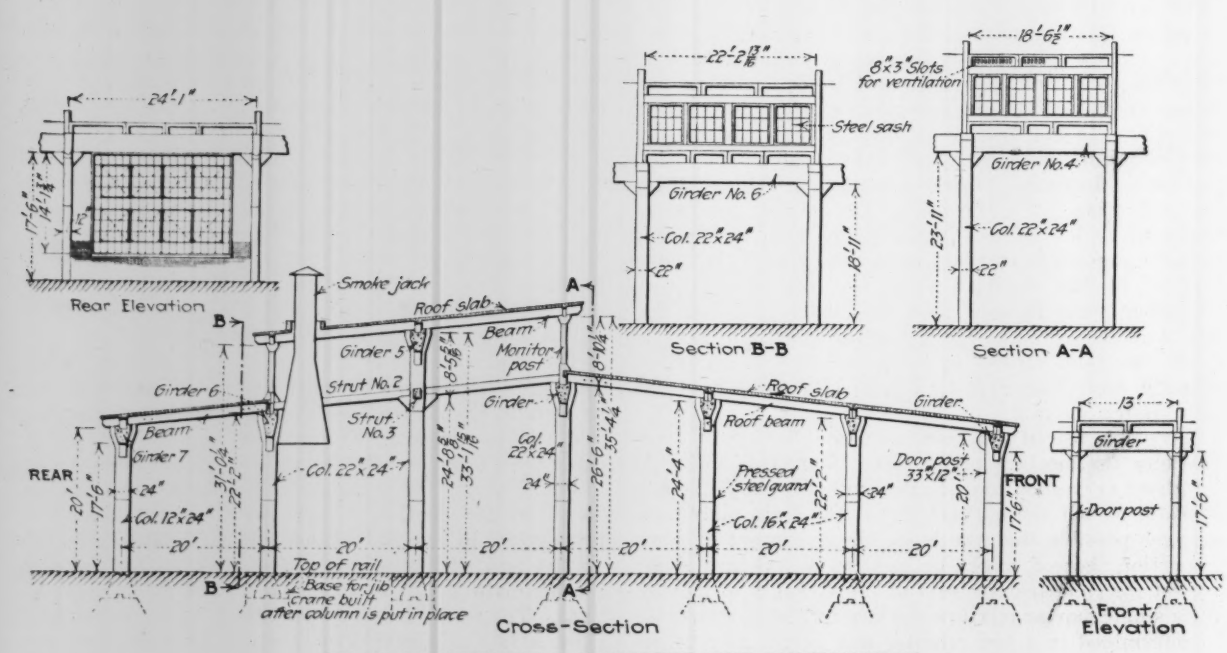


FIG. 2. ROUNDHOUSE OF CONCRETE UNIT CONSTRUCTION

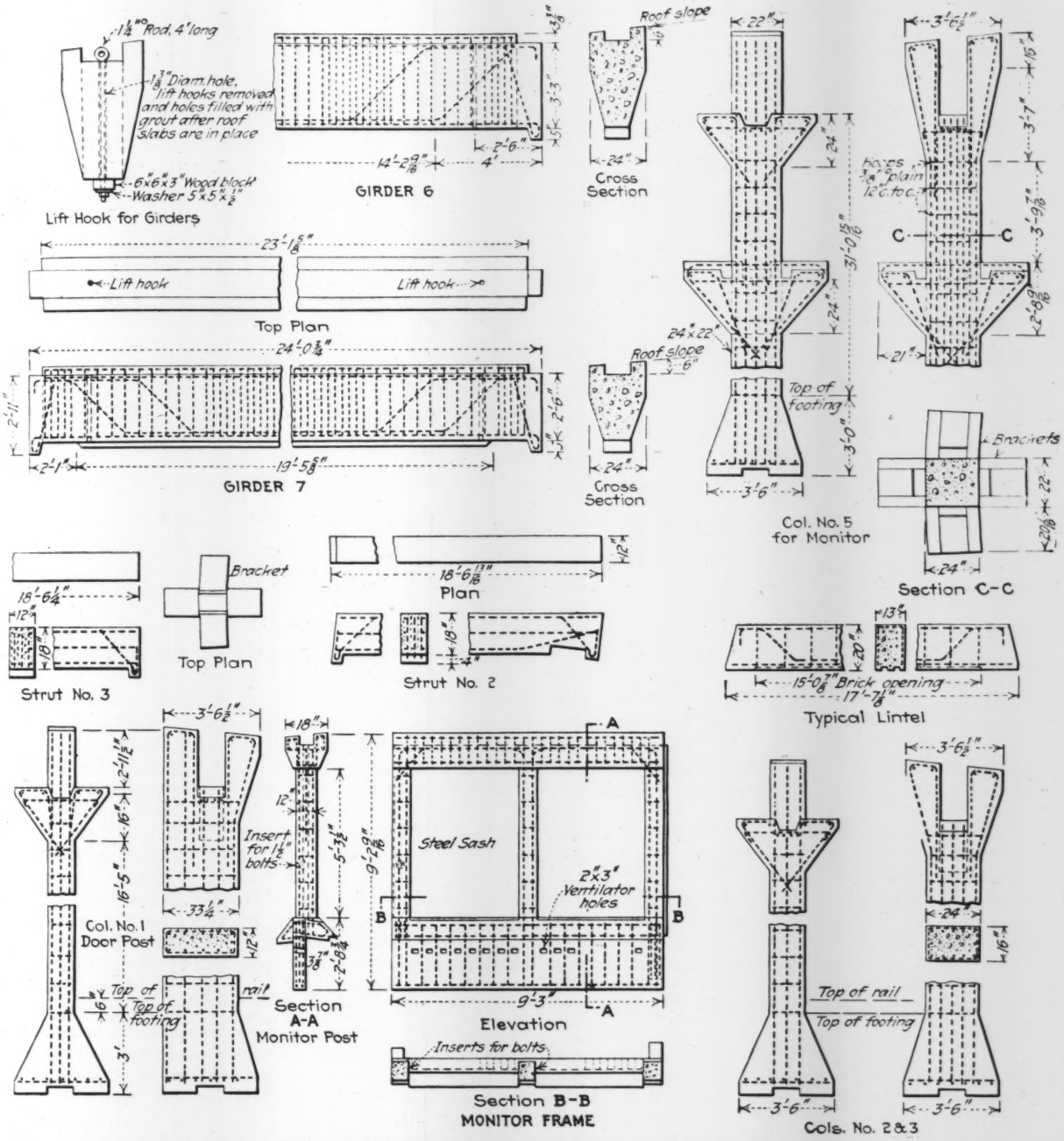


FIG. 3. PRECAST UNITS FOR ROUNDHOUSES; PENNSYLVANIA R.R.

carry short posts which in turn carry lintels supporting the monitor roof joists. But the middle column in each row is made of extra height in order to support the monitor roof girders directly, thus increasing the rigidity of the framing. The building is of ordinary height, being about 17½ ft. in the clear at the walls and 22½ ft. at the middle, increased to 35½ ft. at the high point of the monitor. Cast-iron smokejacks of rectangular section pass through holes 4½ ft. square in the roof slab and are attached to hangers embedded in the joists. Their upper ends connect with flues 40 in. in diameter.

Six of the columns have a uniform width of 24 in. but their thickness varies from 12 to 16 and 22 in. The inner columns or door posts, however, are 12 in. thick with a width of 33¼ in. in order to give the necessary stability for carrying the swinging doors. Steel reinforcement consists of vertical rods with hoops spaced 12 in. apart, but in some cases an octagonal spiral of 6 in. pitch is used instead of the hoops. All columns are enlarged at the base to a 42-in. square bearing on the footings which are 3½ ft. below the floor level. These footings are in a firm gravel formation.

In the center of the column base is a 12 x 12-in.

recess 3 in. deep to engage a similar key or projection on the footing. Details of the columns, girders and beams are shown in Fig. 3.

Floor and Wall Construction—The front or concave side of the roundhouse consists simply of the concrete columns and double-swinging doors of wood construction for the track entrances, these openings extending as high as the lintels. For the outer wall red brick is used, with a large glazed area of wire glass in steel sash. Similar sash and glazing form the sides of the monitor, the sash frames being anchored into recesses in the lintels and posts. The lower part of the monitor, however, is closed by concrete panels having ventilating holes 2 x 3 in. Movable sash for ventilation is provided in the main windows and the monitors.

Creosoted block paving between the engine pits is laid on a 1-in. sand cushion with 4-in. concrete base covering the cinder fill. These pits are 104 ft. long and 4 ft. wide, with 33-in. concrete walls. Upon each wall is a continuous floor of 8 x 8-in. transverse timbers 16 in. long, which project 3 in. over the pit in order to protect the heating pipes laid along the walls. These timbers serve as seats for jacking the engines and to them the 130-lb. track rails are secured by ordinary drive or cut spikes. Two drop pits are provided, each connecting a pair of engine pits and having on the pit floor a track with hydraulic jack for handling wheels. Every column in the fifth row is fitted with a 4-ton swinging jib crane for handling cylinder castings and other heavy parts.

Manufacture of Units—A concrete mix of 1:2:4 is used for the precast units, using ¾-in. gravel for the coarse aggregate. Hydrated lime is added in the proportion of 7½ per cent (by volume) of the cement. These units as well as bridge slabs and other precast members are manufactured by the railway company in a yard at Morrisville, N. J. Three casting platforms 60 x 450 ft. are arranged between four pairs of tracks, with the cement shed, mixing house and hoisting tower beyond the tracks. Two 1-yd. mixers are arranged in a house at an elevation of 30 ft. and supply a 1-yd. bucket in a 100-ft. tower from which a cable-supported chute extends across the platforms. Drop spouts from this main chute supply lateral chutes extending over the platforms and delivering the concrete either directly into the forms or into wheeled carts for distribution to the forms.

To protect the fresh concrete from the weather and also to enable the work to be carried on during the winter, each platform has a traveling roof or shed 100 ft. long. The sheds are provided with heaters. Wood forms are used and are well oiled before each pouring. Concrete is left in the forms for 72 hours and the units are stacked in the yard for at least 30 days before being shipped for erection. In the yard the units are handled by derrick cars and locomotive cranes.

Erection—In erection, the units are handled and placed by locomotive cranes. The heaviest members are the tall columns of the middle row, which weigh about 12 tons each. Other columns weigh about 8 tons, girders 6 to 11 tons, and joists about one ton each. Owing to the broad base the columns are stable when placed on the footings, so that no temporary guy lines are required. Grout is poured over the footing before the column is placed and the joints between columns, girders and beams are grouted when the framing is completed. Concrete for the roof slab will be elevated in a tower and spouted to the form.

This unit system of construction was determined on by A. C. Shand, chief engineer of the Pennsylvania Railroad System. The details were worked out under his direction by H. R. Leonard, engineer of bridges and buildings, and Robert Farnham, assistant engineer of bridges and buildings. Construction of the Pitcairn roundhouse will be done by company forces.

Studying the Physical Property of Road Subgrade Materials

AT THE annual meeting of the American Society for Testing Materials at Atlantic City, June 26-30, J. R. Boyd, of the United States Bureau of Public Roads, read a paper entitled "Physical Properties of Subgrade Materials," which gave in great detail the procedure now being carried out in the Bureau of Public Roads in the testing of subgrade materials. This is an elaborate soil analysis, consisting in an investigation of the finer particles of a subgrade soil, by mechanical analysis, by investigation of the water-holding capacity, so-called moisture equivalent, vertical capillarity, volumetric change, comparative bearing value, and slaking value. As a result of the first year's investigations Mr. Boyd states that there seem to be at least three important factors upon which the physical properties of subgrade soils are dependent; namely, the gradation, which is expressed by the mechanical ratio; the moisture content, which is expresed by the moisture index, and the character of the soil, which is expressed by the adsorption ratio number. These factors influence the physical properties of subgrade soils in the following manner: When the clay content of a soil is increased, its ability to take up and retain moisture is increased and its percentage volume change is increased. The character of a soil influences its percentage volume change as is evidenced by the fact that for increasing adsorption numbers, the percentage volume change increases. When the moisture index of the soil is less than unity, the bearing value will be high; when the moisture index of the soil is above unity, high bearing values can be obtained provided the adsorption of the soil is high.

In the discussion A. T. Goldbeck, also of the Bureau of Public Roads, stated that the tests had been confirmed partly in some field tests, especially in one where adobe subgrade soil had been treated with cement which hardened when wet and increased bearing value of the road remarkably. In the test the dry soil was well broken up and harrowed to a depth varying from 6 to 12 in. and mixed with cement in the proportions of 1 part cement to 10 parts soil, and 1 part cement to 20 parts soil. It was intended to water and roll the surface but rain prevented. One section was allowed to remain untreated for purposes of comparison. A recent inspection showed that the untreated section was badly broken up due to the usual shrinkage cracks characteristic of adobe soils. The treated sections were in good condition and showed no shrinkage cracks. The treatment is not intended to make a hard surface but to alter the properties of soil so that it will be stable and lessen the effects of moisture.

It was also stated by E. O. Fippin (Lime Association) that lime sprinkled over soil had somewhat the same general effect.

New Data on Fire Safety From the Burlington Building Fire

In the remarkable fire which destroyed the sixteen-story office building of the Chicago, Burlington & Quincy R.R. in Chicago on March 15, a great many new facts were brought out concerning fire hazards. Many established facts were confirmed or were modified. Most prominently, perhaps, the serious exposure danger to which modern fireproof office buildings are subjected because of absence of window protection was for the first time brought clearly into view. The danger lying in open floor areas was also made apparent, as was the contributory influence of the heat generated by the burning of ordinary office contents. A summary of the facts and teachings of the fire based on a thorough expert study has been prepared by A. R. Small, vice-president of the Underwriters' Laboratories, who presented it recently before the National Federation of Construction Industries. That part of his summary which is of most direct interest to the structural and fire-prevention engineer is reproduced substantially in full herewith.—Editor.

THE "Q" Building, erected in 1913, was used for the general offices of the Chicago, Burlington & Quincy R.R., its owners. The occupancy throughout the burned floors was a typical office occupancy. The contents were wooden desks and chairs, sheet-metal filing cases, and shelving and paper records of various sorts in and on desks and in the filing cases and elsewhere. Practically no special hazards were present and there was no unusual storage of combustible contents.

Main Structural Elements—The building is of U shape with the closed end to the north, on Jackson Blvd., with a height of 195 ft. and an area per floor of nearly 23,000 sq.ft. It was of steel skeleton or cage construction, with inclosure walls having windows occupying a large proportion of each bay space.

The Clinton St. and Jackson Blvd. fronts were finished with glazed white terra-cotta of somewhat elaborate design; the west and south walls and the walls of the court (which opened to the south) were finished with light glazed terra-cotta brick. Window frames on the two streets, in groups of three, were of wood with wood sash and plain glass, except that on Clinton St. at an outside iron fire escape of the balcony-and-stair type one bay of each floor had hollow metal frames and sash, the center ones with oversized lights of wired glass. The numerous window openings at all floors in the west and south walls were each equipped with a hollow-metal window frame and sash with wired glass. The court window frames were mostly of wood with wood sash and plain glass. The floor arches were of hollow tile, side construction, 3-cell, 15 in.; in the 10th, 13th and 15th floors there were superimposed on them 20 in. hollow tile (3 in. thick, on edge) laid on 4½ in. cinder concrete, to accommodate reinforced concrete ventilating ducts.

Horizontal members of the steel frame were protected with hollow tile according to general practice. The columns were protected with 3 to 4 in. of concrete, and in some cases with 3 in. tile in addition. Corridor and room partitions were of 3 in. hollow tile, with trim, transoms, doors, frames and bucks of wood. All interior wall and ceiling surfaces had plaster finish without furring except in the president's offices. Considerable marble trim was employed in main corridors and elsewhere on each of various floors.

The main passenger elevators, in two opposite banks, had cast-iron grill doors and fixed panels with wired-glass lights of small area (about 10 x 18 in.). Adjoining to the west was the principal stair shaft, with hollow metal doors in pairs at each floor, each door with upper panel of wired glass in two lights and a hollow metal transom with four lights of wired glass. The door frames and bucks at these openings were of steel. The same equipment was provided for the other stairshaft in south-east corner.

Vaults for storage of records were located on each floor adjoining the east bank of elevators. They had double walls on three sides of 4 in. hollow tile with a 6 in. center space filled with broken tile concrete. They had the usual vault door equipment consisting of an outer single swinging door of steel plate with heavy lock bolts and inner steel plate doors in pairs, recessed in an iron frame 20 inches deep.

Vaults Intact—The vaults on each floor when opened were found to have preserved their contents, there being practically no damage in any of them from either fire, smoke or water. Similarly the 3-in. tile enclosures of the ventilating and air washing machinery prevented entrance of fire or excessive heat. Elsewhere, everything combustible was consumed on floors 10 to 15 inclusive. Tile partitions mostly fell, and if not down were insecure; the plaster finish largely fell; the wood flooring and nailing strips burned out from the 9th to the 15th floor.

Stair Shafts Secure—The hollow-metal doors prevented entrance of the fire into either stair shaft. Some blistering of paint within the shaft from radiation took place but the stairs were capable of accommodating people either for exit or refuge or for fire fighting during the entire period of the fire. Had the transoms been omitted and also the wire glass in the upper panels of the doors, there would be no material evidence in either stairway that a fire had occurred.

The cast-iron frames to the openings at the elevator landings warped badly but the wired glass because of the small dimensions employed quite generally remained in place. The elevator equipment was not seriously damaged and was in use within 24 hours. The absence of furniture and other combustibles in the immediate vicinity of these elevator doors no doubt had a substantial bearing on this result.

Wired glass in the hollow-metal frames and sash in the west wall [opposite to the side from which the fire came—Editor] collapsed very generally, due to the fire temperatures reached on the various floors. The frames and sash do not show material distortion. Many of the lights of wired glass in hollow-metal frames and sash in the south wall (not in the court) were still capable of resisting passage of flame following the fire.

The terra cotta tile on the north and east exterior walls (Clinton and Jackson) was badly damaged. Appearance and public safety required its removal from the 8th floor level to the cornice. Of interest is the spalling of projecting ogees, and other ornamental details. These parts in falling added to the glass shower which hampered the work of the department on the sidewalks below in the early stages of the fire.

Columns, Beams and Floors—The concrete served fully to protect the steel columns in every case. Paint on the steel was not softened. Only surface dehydration of this concrete occurred and this was not universal.

Generally speaking the soffit tile similarly protected the steel floor beams and girders, although they were observed to have fallen from a single beam in the 12th floor at the south end of the west wing and from another in the 14th floor at the center of the east wing. There are a few spots on various floors where the soffits of the floor-arch tile have fallen. The plaster fell so generally on the 10th and 14th floors that cracks in soffit corners in arch tile may be common. The cinder concrete fill was dehydrated only very slightly; its insulating value was hardly impaired.

The T-bar mullions in the street front and other triple window openings warped, generally outward near the upper end. There was no provision for their expansion. The terra cotta and tile casings for these mullions failed and fell in many cases. The steel lintel plates in these openings show but little evidence of warping.

The service equipment, such as steam piping, electric conduit and water piping is not materially damaged. There was heat in steam radiators on all floors a day or two after the fire.

The roof covering, which is of flat tile embedded in pitch or asphalt, is not damaged. The projecting cornice deflected the heat wave so that the roof was not exposed.

The east wing was 16 stories high without windows or other openings in the 16th floor. There was no fire damage on this floor.

Lessons of the Fire—If the "Q" Building had been of seven stories or less it would have suffered little damage comparatively from the exposure to which it was subjected. This single-building loss duplicates on a smaller scale the circumstances of the Baltimore and San Francisco conflagrations, the particular lesson of which was the horizontal spread of heat waves at high levels.

Fire exposure *in the case of high buildings* exists at distances much in excess of the 50-ft. maximum now recognized by many organizations, or the 30-ft. limit of most building codes. Street widths or other clearance must exceed building heights by perhaps 100% for a severe fire exposure hazard to disappear even when only moderate winds are considered. Unprotected window openings invite similar burnouts in so-called "fireproof" buildings wherever severe fire exposure exists.

Wired glass in areas not exceeding 720 sq.in. and mounted in metal frames would probably have prevented entrance of the heat wave into the upper floors. In any event it would have delayed its entrance for a considerable time. If, in addition, window sprinklers had been provided and used, wired glass in standard metal frames perhaps even with lights greater than 720 sq.in. would have prevented entrance of the heat wave into the building and probably would also have materially lessened the damage to the terra-cotta exterior finish.

The stairway enclosures functioned nearly 100% and fire did not communicate from floor to floor within the building.

Wired glass in doors, transoms or elsewhere in stairways and other enclosures to vertical openings should be avoided; when used, it should be in small lights, not exceeding 10 x 15 in., and these should be as few as possible.

A horizontal cut-off equivalent to a 1½-hr. fire division wall would have confined this fire to the east wing.

It is clearly wasteful to erect partitions of fire-resisting materials and then to equip them with combustible trim at doors and transoms. The only possible advantage is the reduction of the quantity of fuel, which advantage was of no account in the "Q" Building fire.

Wired glass cannot long withstand temperatures reaching 1,200 deg. F. on both sides or 1,700 deg. F. on one side. At these temperatures it softens so that its weight pulls it from the sash grooves.

The average fire temperatures in the "Q" Building did not exceed 1,800 deg. F., if indeed they reached this point. The ruins suggest a fire of a severity not greatly exceeding the conditions obtained in a 1½ hour test.

Single-cell hollow-tile partitions will not remain in place when subjected to the expansion stresses set up by a fire exposure such as prevailed here and subjected to the forces of sudden cooling and impact from hose streams.

The 3 to 4-in. concrete on the steel columns provided ample fire protection for the exposure which was obtained.

Terra-cotta exterior finish, as employed quite generally in Chicago, is subject to spalling and other material damage from the heat of exposing fires of any intensity or duration. Most other materials of value from a decorative point of view are subject to similar damage, at least to some degree.

Wood furniture and trim and similar combustible material of a "fireproof" building not only are subject to total loss but add fuel to the fire.

The single-wall steel filing cases failed completely to protect their contents.

Automatic sprinklers probably would not have controlled the fire, but very likely would have done so if all the window openings had been protected with standard fire window frames with wired glass.

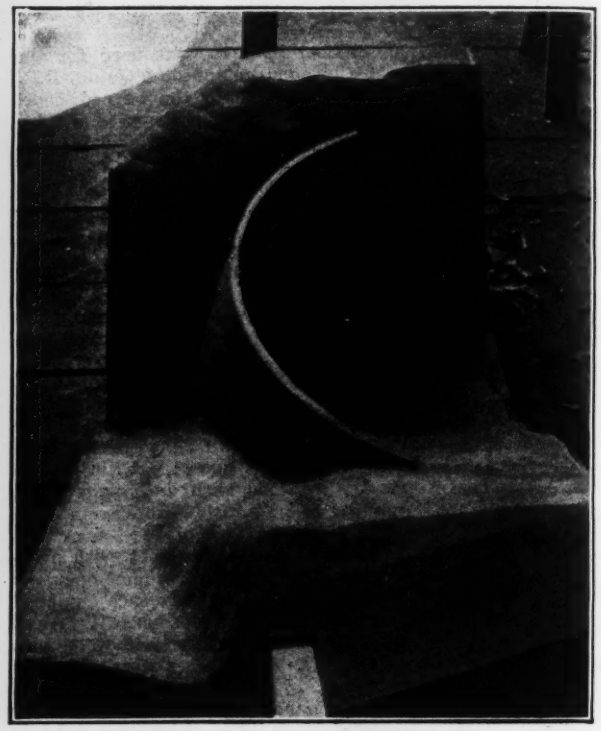
The rolling steel shutters in the court windows at the 10th and 15th floors at the ventilating machinery rooms prevented passage of flames. The heat radiated from these shutters blistered the paint on both sides of steel partitions at least 18 in. behind the shutters.

The vaults preserved their contents. They were subjected to a moderate fire exposure. The paint on the inner doors blistered. With a mercantile or industrial occupancy including stocks of combustible goods and a complete burnout such as occurred in this building, such vaults would be likely to fail from radiation through the iron doors.

Types and Costs of Concrete Dams Compared by Models

IN MAKING final studies of the comparative costs and advantages of several types of dams to be built in California on the Merced River for the Merced Irrigation District, models of three types under consideration are being used. In addition to facilitating explanation and discussion before the district's board of directors, each model is used as a check on the estimated yardage in the proposed dam by measuring the displacement in water. Another advantage of the plan is said to be in making the layout of the construction plant. R. C. Starr, under whose direction the work is being done, states, "it is much easier to make a construction plant layout, determine chute slopes, trestle locations, etc., from models than from blueprints."

The first step in making the models was the construction of a relief map of the damsite, each contour being built up in wood on a scale of 20 ft. to the inch, or 1 to 240 both horizontal and vertical. After waxing the side slopes to prevent concrete from sticking to them, up-and downstream forms were placed and concrete was poured in a miniature dam. This process was repeated for the three types under consideration—gravity arch, pure arch and constant-angle arch dams. As the three structures were made from the same materials, the weights as shown by water displacement were used to check the estimated comparative yardages.



MODEL OF MERCED IRRIGATION DISTRICT ARCH DAM
Concrete towers, chutes and cableways were actually built around the dam on the same scale to show the relative positions and appearance of the construction plant completely assembled.

Mr. Starr credits the idea of using models in this way to R. L. Bryant, resident engineer, and J. D. McDougald, general superintendent, on the Merced project.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Professor Swain's New Book

Sir—On reading your review of Prof. Swain's "The Young Man and Civil Engineering," I decided to get a copy of the book. After reading it from cover to cover I decided to buy several copies and send them around to places where I thought they would do good. In my opinion Prof. Swain has treated his subject in a manner that will have a far reaching good influence on the young men contemplating civil engineering as a profession and the young men who are actually in school.

If I could afford it I would send a copy of the book to every student in every engineering college in the United States because of my belief that Prof Swain's criticisms are just and practical and point the way to better work than we have been getting from our engineering schools for a long while.

I have had, as you know, about thirty years of experience with college graduates and their usefulness when they come out of school shows to me conclusively there is something very wrong in the way our colleges have been handling this all-important question of fitting young men for engineering work.

New York City. HUGH L. COOPER.

Mechanical Testing in Great Britain

MECHANICAL TESTING: A Treatise in Two Volumes. Vol. I, Testing of Materials of Construction—By R. G. Batson, M. Inst., C. E., M. I. Mech. E., Associate of King's College, London, Senior Assistant in the Engineering Department of the National Physical Laboratory, Teddington; and J. H. Hyde, A. M. Inst. C. E., M. I. A. E., A. M. I. Mech. E., Senior Assistant in the Engineering Department of the National Physical Laboratory, Teddington. [The Directory-Useful (D. U.) Technical Series.] New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 413; illustrated. $9.

In materials testing there are usually many ways of carrying out a given test, but the results obtained by the different procedures will not always be comparable, and some methods are found to correlate better than others with practical experience concerning the resistance of material. Largely from these conditions there has arisen a picturesque variety in forms of test and devices for testing, a variety still further complicated by the fact that standardization has attempted to produce certain fixed points in the field. It is obviously necessary that every man engaged in testing should be familiar in detail with the many kinds of tests and testing machines. The author of this work has therefore performed a useful service in presenting a condensed catalogue of the subject. It will usefully supplement other works of the same kind, for no single work is quite complete or covers each detail with equal thoroughness. The continuous progress made in interpretation of tests, moreover, causes the subject to change as the years go by; in fact, it appears that some passages in the present work are already superseded by later information, particularly in the field of repeated-stress testing.

It is necessary for the reader to know as a characteristic of the work only the fact that, being a British work, it is largely foreign as to testing machines and standards, and that one or two of the most important items of the field are treated in a very brief and offhand way. The tension testing machine might be expected to have much space and a great amount of detailed analysis devoted to it, since it is by far the most widely used piece of testing equipment, but it is treated quite summarily. The field of lime and cement testing, which has developed remarkably in recent years, claims large importance because of the extensive use of cement and might properly be given many times the half dozen pages which the present work devotes to it. The same inadequacy is found in tests of road material (9 pages), in which, incidentally, the testing of bituminous materials is passed over entirely.

Science Popularized Without Sacrifice

THE OUTLINE OF SCIENCE: A Plain Story Simply Told—Edited by J. Arthur Thompson, Regius Professsor of Natural History in the University of Aberdeen. Vol. I of Four Volumes [the whole containing] 40 Colored Plates and 80 Illustrations in Black and White. New York and London: G. P. Putnam's Sons. Cloth; 8 x 11 in.; pp. 296. $3.75 per volume.

So far as can be judged from the first of the four volumes, this is a remarkably successful attempt to present, without sacrifice of the scientific spirit, the fundamentals of science in such plain language that any person of average intelligence can readily understand them.

The first volume begins with the Romance of the Heavens, or astronomy and ends with Foundations of the Universe, or the new atomic theory, electricity, radio energy, electrons, etc. Evolution fills the intervening pages, opening with the earth and life upon it, continuing with adaptation to environment, the struggle for existence, the ascent of man and "evolution still going," and ending in the dawn of mind. The illustrations are well chosen and effectively presented. To assist the reader to act upon the stimulus of the work to go further, brief reference lists to other and more detailed books are appended to each chapter.

"The Outline of Science" will doubtless attain as much popularity as Wells' "Outline of History," but it falls in an altogether different category as regards likelihood of adverse criticisms from specialists. This is partly due to the nature of the two subjects and partly to the methods of approach in the two works.

Federal, State and Local Taxation

ESSAYS IN TAXATION—By Edwin R. A. Seligman, McVickar Professor of Political Economy, Columbia University. Cloth; 6 x 9 in.; pp. 782. New York: The MacMillan Co. $4.

The present revision and enlargement of this standard work on taxation includes three new chapters on (1) The War Revenue Acts, (2) Loans Versus Taxes in War Finance, and (3) The Cost of the War and How It Was Met. Besides this hundred pages of new matter, considerable additions have been made at a few points and slight ones in many places. The book is in part a treatise and in part a collection of essays or occasional addresses, each well rounded and up to date when presented. The essays overlap each other and the treatise part of the book both in sub-matter and chron-

ologically. This compels the reader to go back and forth in order to get a consecutive up-to-date story.

Altogether, the book is a detailed exposition of the theory, and to a less extent of the practice, of federal, state and local taxation, with a historical background and an analysis of the legal and economic phases of the subject, and ample deductions from experience.

A few of the many chapter heads, in addition to those already given, follow: General Property Tax; Single Tax; Double Taxation; Taxation of Corporations (three chapters); Betterment Tax; Relation of Federal, State and Local Revenues. The literature of the subject, including the numerous reports of state and local tax commissions created to investigate taxation, are reviewed.

Economics Humanized and Modernized

PRINCIPLES OF THE NEW ECONOMICS—By Lionel D. Edie, Associate Professor of History and Politics Division of Current Industrial Problems, Colgate University. New York: Thomas J. Crowell Co. Cloth; 6 x 9 in.; pp. 525. $2.75.

The keynote of Prof. Edie's book is struck in its first sentence: "Economics is the science of human nature in its relations to the ordinary business of life." Before proceeding with abstract theories he considers human instincts and their application to modern economic conditions. In describing the machinery of modern industry and commerce Prof. Edie brings home to the average man principles that otherwise would seem to be of little practical significance.

The application of the conventional economic principles he treats under five main heads: Labor, capital, management, markets, and money and credits. The treatment of all these, however, is specific, up-to-date and practical rather than according to abstract and classical methods. Throughout the reader is made to see that however perfect in all its parts, and however nicely articulated may be our economic machinery, its motive power flows from mankind, and that results obtained from the machine will be measured by the intelligence with which that power is directed. "Economics," the author says, "is not mainly the science of things; it is the science of life. It concerns the realization of human energies, and at the basis of all economic behavior lies instinctive nature."

Prof. Edie closes his work with a discussion of public control, economic radicalism and economic democracy, treating these moot questions from the expository rather than the controversial standpoint.

The author has done so good and important a piece of work that we regret to note that in the part of the book dealing with the "Scientific Basis of Economics" there appears here and there a trace of the "pseudo-science" and inaccuracy that we have become accustomed to expect in the Sunday-supplement and popular-magazine article. To illustrate: On p. 74 the author talks of electricity as though it were a source of power instead of a means for transmitting power. In his discussion of water power on p. 75 is found similar confusion of thought. In his statement on p. 81 as to the likelihood of a "super-power zone" being developed in the Boston-Washington district within the next few years, Prof. Edie has apparently succumbed to the super-power propaganda. On p. 91 reference is made to the Federated American Engineering Societies as a central association "for the purpose of advancing the sciences of technical engineering," whereas its purpose is non-technical. We suggest to Prof. Edie that in his next edition he submit this portion of the book to the scrutiny of a technical critic, as, judging from his preface, he has done with sections dealing with the commercial and financial aspects of his subject.

American and British Local Government

THE MODERN CITY AND ITS GOVERNMENT—By William Parr Capes, Secretary New York State Conference of Mayors, Director New York State Bureau of Municipal Information. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 269; 15 organization charts. $5.

HANDBOOK OF MUNICIPAL GOVERNMENT—By Charles M. Fassett, Specialist in Municipal Government at the University of Kansas; former Mayor of Spokane. New York: Thomas Y. Crowell Co. Cloth; 5 x 8 in.; pp. 192. $1.50.

ASSETS OF THE IDEAL CITY—By Charles M. Fassett, Specialist in Municipal Government at the University of Kansas; former Mayor of Spokane. New York: Thomas Y. Crowell Co. Cloth; 5 x 8 in.; pp. 177. $1.50.

THE LOCAL GOVERNMENT OF THE UNITED KINGDOM—By John J. Clarke, M.A., F.S.S., Lecturer in Law of Housing and Town Planning in the University of Liverpool; Lecturer in Public Administration, Local Government and Citizenship for the Liverpool Education Authorities. With a Foreward by Sir Homewood Crawford. London, Toronto, New York: Sir Isaac Pitman & Sons, Ltd. Cloth; 5 x 7 in.; pp. 374. 8s.

Of these four books on municipal government, the first three deal primarily with principles, methods and results in America, while the fourth is a detailed analysis of actual practice in England, Wales, Scotland and Ireland, with historical backgrounds and summaries of Parliamentary statutes and administrative practice.

Mr. Capes concentrates on a few main subjects, such as the fundamentals of municipal government, the selection of officials, charters and their three chief types (federal, commission and commission-manager), education, and efficiency and cost of government. Mr. Fassett in his "Handbook" touches upon all these subjects and numerous sub-topics, besides many details of administration, but the book is so small and so many subjects are taken up that the presentation of each subject is brief and sketchy. Mr. Fassett's second volume, "Assets of the Ideal City," is in part a repetition and in part an extension of the first, the extension being chiefly on administrative details. The two volumes might have been combined, duplications omitted, and the treatment of some of the more important subjects expanded without making a book either unduly large or expensive.

Mr. Capes' book is suited to the advanced student and fairly well informed citizen or municipal official. One of its valuable features is its discussions and summaries of the advantages and disadvantages of the three main types of city government now prevalent, considered simply and one type against the others. Mr. Fassett's "Handbook" is more elementary and, as already indicated, more sketchy. Both authors have had experience in and much observation of municipal government, and herein and in the recentness of the books lie their chief claims for attention as compared with the many earlier books on municipal government.

Mr. Clarke's "Local Government in the United Kingdom" is a concise, readable and masterly review of parish, district, borough, county and London government in the United Kingdom, including the many relationships of the central and local governments. It includes post-war legislation and its effects.

A commendable feature of each of the four books is a carefully selected classified bibliography. All the books lay stress on the duties of citizenship and on administrative efficiency. All recognize the place of the technically trained man in municipal administration. All are singularly free from statements on engineer-

ing and allied subjects that surprise the well-informed municipal engineer and are likely to mislead the layman. Strangely enough, in view of the statement in H. S. Buttenheim's Foreword to the "Handbook" that Mr. Fassett is "a successful engineer," it is this author who makes the largest number of questionable statements regarding engineering matters—but he deals more extensively with these than do the other authors. It may be added that Mr. Fassett's exposition of the functions of a city health department seems to be one of the least adequate sections in either of his two interesting and suggestive books.

A Magnificent Record Ably Presented

A HALF-CENTURY OF PUBLIC HEALTH: Jubilee Historical Volume of the American Public Health Association. In Commemoration of the Fiftieth Anniversary Celebration of Its Foundation, New York City, Nov. 14-18, 1921—Edited by Mazyck P. Ravenel, M.D., President. New York: American Public Health Association. Stiff paper; 7 x 10 in.; pp. 461; frontispiece portrait of Stephen Smith, M.D., Founder and First President of the Association. $3.75; cloth, $5.25.

Such occasions as the semi-centennial of the American Public Health Association have often and always should have as one of their best fruits the presentation of the history, present status, and future needs of the various fields in the domain of the association concerned. The record in the present volume is magnificent and the presentation by the nearly two-score reviewers and forecasters is ably done.

Rarely can any association listen to an address by its first president fifty years after its organization. Dr. Stephen Smith, himself nearly a centenarian, is fittingly given first place in this volume. There follows a history of the American Public Health Association and sketches of its deceased presidents, and also of Dr. Smith, prepared by Dr. Ravenel, editor of the volume and president of the association last year. Various aspects of sanitation and public health are reviewed by specialists, among others Bacteriology, by Prof. F. Gorham; Water Purification, Prof. George C. Whipple; Sewage and Refuse Disposal, Dr. Rudolph Hering; Stream Pollution and Industrial Wastes, Earle B. Phelps; Milk, Dr. Charles E. North; and Ventilation by Dr. George T. Palmer; State and Municipal Control of Disease, Dr. Charles V. Chapin; Mortality Progress, by Dr. F. L. Hoffman.

The volume should be of interest and value to sanitarians and health workers generally, including many engineers engaged in municipal work in an official or consulting capacity.

Elementary Text on Landscape Gardening

TEXTBOOK OF LANDSCAPE GARDENING—Designed Especially for the Use of Non-Professional Students. By Frank A. Waugh. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 7 x 10 in.; pp. 344; illustrated. $5. (25s. net.)

The elements of landscape gardening are here presented in a manner well designed to meet the needs of students who do not intend to become professional landscape gardeners. Some 30 pages are devoted to surveying, leveling and mapping. Chapters follow on landscape gardening details, architectural details, domestic landscape gardening, civic problems, plant materials and planting, and landscape in its broader phases, extending to parks and reservations. Exercises for the student are provided. There are a few references to books and articles at the close of each chapter, and a short bibliography at the end of the book.

PUBLICATIONS RECEIVED

THE A.B.C.'s of CALCULUS—By C. C. Carpenter, C. E., Ada, Ohio: The Author. Cloth; 4 x 7 in.; pp. 78. $1.50.

Calculus as usually taught is a formidable subject which, unfortunately, is rarely retained by those who study it. This little book is an effort, and a fairly successful one, to simplify the introduction to the study of calculus so as to make its principles more plain and thus to insure their retention. It will be useful, too, in refreshing the memory of those engineers who have forgotten most of their calculus.

AMERICAN CONCRETE INSTITUTE: Proceedings, 1922—Detroit, Mich. Paper; 6 x 9 in.; pp. 449; illustrated.

ANALYSIS AND CLASSIFICATION OF PERFORMANCE IN VOCATIONAL RELATIONS—By J. Osborn Hopwood, M.S. (Yale) Of the Personnel Department of The Philadelphia Electric Co. Formerly of the Emergency Fleet Corporation, Instructor, Operative, etc. Boston: Richard G. Badger. Cloth; 5 x 8 in.; pp. 128. $1.75 net.

BACTERIA FERMENTING LACTOSE and Their Significance in Water Analysis—By Max Levine, Bacteriologist Iowa Experiment Station and Associate Professor of Bacteriology, Iowa State College, Ames, Iowa; Engineering Experiment Station. Paper; 6 x 9 in.; pp. 127; illustrated.

Sections on the colon group, under characteristics, tests for differentiation, classification, detection, and index of pollution; one section on spore-forming lactose fermenters and their significance; appendixes on routine methods of analysis and culture media; 205 references.

BEAUTIFUL HOMES OF MODERATE COST—A Selection of Modern, Artistic, Practical Designs by Well Known Architects, Together with Information on Planning, Financing, Construction, Decoration and Furnishing. New York: Building Age and the Builders' Journal. Paper; 9 x 12 in.; pp. 96; illustrated. $1.

BRUCKEN IN EISENBETON: Ein Leitfaden für Schule und Praxis—Von C. Kersten, Vorm. Oberingenieur Studienrat an der Baugewerkschule Berlin. Teil II., Bogenbrücken. Vierte Neubearbeitete Auflage. Berlin: Wilhelm Ernst & Sohn. Paper; 7 x 10 in.; pp. 228; 521 illustrations.

BUILDING CONTRACTS: The Principles and Practice of Their Administration—By Edwin J. Evans. Foreword by Sir Charles T. Ruthen, O.B.E., F.R.I.B.A.H.M. Director-General of Housing and President of the Society of Architects. [The Directly-Useful (D.U.) Technical Series.] New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 304.

COLUMBIA BASIN PROJECT—A Report by George W. Goethals & Co., Inc., to Department of Conservation and Development of the State of Washington. Olympia, Wash. Paper; 6 x 9 in.; pp. 56; folding map and halftones.

A brief summary of Col. Goethal's report on this vast irrigation project appeared in *Engineering News-Record*, April 20, 1922, p. 666.

CONCRETE COMPUTATION CHARTS—By Richard T. Dana, M. Am. Soc. C. E., M. A. I. M. & M. E., Chief Engineer, Construction Service Co., and James M. Kingsley, B.S. New York: Codex Book Co., Inc. Cloth; 9 x 12 in.; pp. 14; 21 charts. $5.

Design diagrams for reinforced concrete are numerous but few have found their way into books. This set seems to be complete and accurate. Whether they will be used depends a good deal on the taste and fancy of the prospective user.

DAILY RIVER STAGES OF THE PRINCIPAL RIVERS OF THE UNITED STATES, 1920—By H. C. Frankenfield, Meteorologist. Washington, D. C.: U. S. Weather Bureau. Paper; 9 x 12.; pp. 182.

THE DESIGN OF MASONRY STRUCTURES AND FOUNDATIONS—By Clement C. Williams, C.E., M. Am. Soc. C. E., Professor of Civil Engineering, University of Kansas; Consulting Engineer. New York: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 555; 265 illustrations. $5.

DEPARTMENT OF HIGHWAYS, ONTARIO: Report for 1920. Ottawa. Paper; 6 x 10 in.; pp. 70.

DETERIORATION OF STRUCTURES IN SEA-WATER—Second (Interim) Report of the Institution of Civil Engineers. Edited by P. M. Crosthwaite, B. A. L., M. Inst. C. E., Secretary to the Committee, and Gilbert R. Redgrove, Assoc. Inst. C. E., [Department of Scientific and Industrial Research of the British Government.] London: His Majesty's Stationery Office. Paper; 6 x 10 in.; pp. 57; illustrated. 2½s. net.

Addition to the main report (reviewed in *Engineering News-Record*, June 17, 1920), giving mainly the results of some zoölogical studies of marine borers and adding to some of the report data from various parts of the world.

DOMINION WATER POWER BRANCH; Report for 1920-21—Ottawa, Ont. Paper; 6 x 10 in.; pp. 89.

DWELLINGS AND FAMILIES: 1920 Census—Washington, D. C.: Bureau of the Census. Paper; 9 x 11 in.; pp. 14.

EFFECT OF COLOR OF WALLS AND CEILINGS ON RESULTANT ILLUMINATION—Compiled by A. L. Powell, Lighting Service Department, Edison Lamp Works, General Electric Co., Harrison, N. J. Paper; 6 x 9 in.; pp. 15; 36 color samples of tints, paints and wall papers with corresponding percentages of reflection from mazda lamps.

THE GANTT CHART: A Working Tool of Management—By Wallace Clark, M. Am. Soc. M. E., M. Taylor Society. With Appendices by Walter N. Polakov and Frank W. Trabold. New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 155. $2.50.

A GUIDE TO THE OPERATION OF SEWAGE TREATMENT PLANTS—By Burns & McDonnell Engineering Company, Consulting Engineers, Kansas City, Mo. Paper; 4 x 6 in.; pp. 8.

HYDRAULIC LABORATORIES IN THE UNITED STATES OF AMERICA: A Descriptive Directory—Compiled for the Hydraulic Research Committee of The Engineering Foundation (J. Waldo Smith and Silas H. Woodward) by Alfred D. Flinn, Secretary, Engineering Societies' Building, New York City. Paper; 6 x 10 in.; pp. 79. Price not yet fixed.

Describes 49 laboratories under a dozen heads, including owner, date established, kind of tests, head, principal equipment, unusual facilities, whether available to outsiders, railway station or siding, person in charge, number on staff, brief general description, research work. Lists eight other laboratories. Contains no summaries or comment but is welcome as probably the first compilation of the kind ever made.

INSECT LIFE ON SEWAGE FILTERS—By W. H. Parkinson, M.D., D.P.H., M.Q.H. to the Basford R.D.C. and Beeston U.D.C., and H. D. Bell, A.I.C., Manager and Chemist of the Stratford-upon-Avon Sewage Disposal Works, and Consulting Chemist on Deodorization of Sewage Disposal Works. London: The Sanitary Publishing Co., Ltd. Cloth; 5 x 8 in.; pp. 64.

Observations on Achorutes viaticus, beginning at the contact beds of the sewage-works of Manchaster, England, in 1904 and including research work in 1914-16. Published in 1919, but not previously noted in these columns.

THE INTERNATIONAL LABOR ORGANIZATION OF THE LEAGUE OF NATIONS—Report, National Industrial Conference Board—New York: The Century Co. Paper; 6 x 9 in.; pp. 159; frontispiece map.

AN INVESTIGATION OF THE PROPERTIES OF CHILLED IRON CAR WHEELS—Part I. Wheel Fit and Static Load Strains. Conducted by J. M. Snodgrass and F. G. Guldner. Bulletin 129, Engineering Experiment Station, University of Illinois, Urbana, Ill. European Agents, Chapman & Hall, London, England. Paper; 6 x 9 in.; pp. 95; line cuts and half tions. 55c.

IRON ORE: PART II; BRITISH AFRICA—Summary of Information as to the Present and Prospective Iron-Ore Supplies of the World. [Imperial Mineral Resources Bureau.] London: H. M. Stationery Office. Boards; 6 x 9 in.; pp. 76; folding map. 3¼s.

IRRIGATION IN MADRAS PRESIDENCY: Report for 1920-21—Madras: Superintendent Diocesan Press. London: Constable & Co. Paper; 8 x 13 in.; pp. 210; folding maps. 2 rupees 12 annas.

LOUISIANA BOARD OF STATE ENGINEERS—Report for 1921-22. New Orleans, La. Paper; 6 x 9 in.; pp. 213.

MEXICAN PETROLEUM—New York: Pan American Petroleum & Transport Co. Flexible; 6 x 9 in.; pp. 300; half tones and folding map.

MODERN CITY PLANNING: Its Meaning and Methods—By Thomas Adams, Town Planning Consultant to the Dominion of Canada, Lecturer on Civic Design, Massachusetts Institute of Technology. New York City: The National Municipal League. Paper; 6 x 9 in.; pp. 21. 50c.

A concise review of principles and methods which rounds out a series of pamphlets issued by the National Municipal League. The others (25c. each) are: The Law of the City Plan, by Frank B. Williams; Zoning, by Edward M. Bassett; Law of Zoning, by Herbert S. Swann; Special Assessments, by the League's Committee on Sources of Revenue.

MODERN PRACTICE IN HEAT ENGINES—By Telford Petrie, Lecturer in Mechanical Engineering in the Victoria University of Manchaster and in the Manchester Municipal College of Technology. London and New York: Longmans, Green & Co. Cloth; 8½ x 11 in.; illustrated. $5 net.

Covers steam boilers, steam turbines and engines, and internal combustion engines. Supplements the late W. Inchley's "Theory of Heat Engines."

NATIONAL FOREIGN TRADE CONVENTION: Proceedings 1922 Meeting—New York: Address the Secretary (as above), India House, Hanover Square. Cloth; 6 x 9 in.; pp. 615.

THE NEW INTERNATIONAL YEAR BOOK: A Compendium of the World's Progress for the Year 1921. Editor, Frank Moore Colby, M.A. New York: Dodd, Mead & Co. Cloth; 7 x 10 in.; pp. 776; maps and halftones. $6.75.

The twentieth issue of this useful annual. As usual, the engineering and the other sciences and arts are reviewed and careful attention is given to the various industries, economics, and public questions.

NEW SOUTH WALES DEPARTMENT PUBLIC WORKS: Report for 1920-21—Sydney. Paper; 11 x 13 in.; pp. 85; illustrated.

NOTES ON MECHANICAL DRAWING—By Rolland S. Wallis. (Industrial Education) Ames, Iowa; Engineering Extension Department, Iowa State College. Paper; 6 x 9 in.; pp. 64; 87 line cuts. 50c.

OFFICIAL YEAR BOOK OF THE COMMONWEALTH OF AUSTRALIA, Containing Authoritative Statistics for 1901-20 and Corrected Statistics for 1788-1900—Prepared by G. H. Knibbs, Formerly Commonwealth Statistician, and Completed by John Stoneham, Editor. Melbourne, Australia: Commonwealth Bureau of Census and Statistics. Boards; 7 x 10 in.; pp. 1228; maps and diagrams.

PETROLEUM: WHERE AND HOW TO FIND IT—By Anthony Blum. Chicago: Modern Mining Books Publishing Co. London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 367; frontispiece portrait of author. $2.

PLAN OF NEW YORK AND ITS ENVIRONS: Report of Meeting of May 10, 1922 (at which announcement was made of the Regional Survey in progress). New York: Russell Sage Foundation, 130 E. 22nd St. Paper; 7 x 10 in.; pp. 25.

PRACTICAL ACCOUNTING FOR GENERAL CONTRACTORS—By H. D. Grant, Staff of W. B. Richards & Co., Accountants and Engineers, etc. Cloth; 6 x 9 in.; pp. 254. $3.

THE PROBLEM OF DUST PTHISIS IN THE GRANITE-STONE INDUSTRY—By Frederick L. Hoffman, LL.D., Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 178. 20c. from Superintendent of Documents, Washington, D. C.

PROTECTION FOR BUYERS OF PINE: Report of Annual Meeing of Subscribers to Southern Pine Association, March 28-29, 1922—New Orleans, La. Southern Pine Association. Paper; 6 x 9 in.; pp. 264.

PUBLICITY METHODS FOR ENGINEERS: A Manual for Men Engaged in Public Information Work—Proceedings of the First National Conference on Public Information Held Under the Auspices of the American Association of Engineers, 63 East Adams St., Chicago. Cloth; 5 x 8 in.; pp. 186; illustrated. $1.50.

REPORT ON THE FIXATION AND UTILIZATION OF NITROGEN—Prepared by the Nitrate Division, Ordnance Office, War Department; Assisted by the Fixed Nitrogen Research Laboratory, Department of Agriculture, Washington. Paper; 6 x 9 in.; pp. 353.

Reviews world nitrogen situation, with statistics; gives history, chemistry, construction and operating of various fixation processes; describes United States government plants.

THE ROCKEFELLER FOUNDATION—A Review for 1921. By George E. Vincent, President of the Foundation. Paper; 6 x 8 in.; pp. 59, illustrated.

THE SCIENCE OF PURCHASING—By Helen Hysell. With an introduction by J. George Frederick, Author of "Modern Salesmanagement." New York: D. Appleton & Co. Cloth; 5 x 8 in.; illustrated. $2.50.

STATE ENGINEER AND SURVEYOR OF NEW YORK: Report for 1920-21. Cloth; 6 x 9 in.; illustrated. Vol. I., Report of Chief Engineer F. M. Williams, Senior Assistant Engineers, Testing Laboratory, etc.; Vol. II, Report on Stream Gagings.

STATISTICS OF THE RAILWAYS OF THE UNITED STATES, 1919—Washington, D. C.: Interstate Commerce Commission. Cloth; 9 x 11 in.; pp. 819. $1.50 from Superintendent of Documents, Washington, D. C.

STEAM TURBINES—By William J. Goudie, D. Sc., M. Inst. M. E., Assoc. M. Inst. C. E., James Watt, Professor of The Theory and Practice of Heat Engines in the University of Glasgow. Second Edition, Rewritten and Enlarged. London and New York; Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 804; 392 illustrations. $9.

The general scheme of the first edition (published in 1917) has been followed. A chapter on reduction gears, with special reference to marine turbines, has been added and other matrial additions and revisions made.

TEXTBOOK OF LANDSCAPE GARDENING, Designed Especially for the Use of Non-Professional Students—By Frank A. Waugh. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 7 x 10 in.; pp. 344; illustrated. $5. (25s. net.)

THERMAL EXPANSION OF A FEW STEELS—By William Sander, Physicist, and Peter Hindert, Associate Physicist, Bureau of Standards, Washington, D. C. Paper; 6 x 9 in.; pp. 16. Free from Bureau of Standards until stock exhausted; 5c. from Superintendent of Documents.

THERMAL STRESSES IN CHILLED IRON CAR WHEELS—By G. K. Burgess and R. W. Woodward, Physicists, Bureau of Standards, Washington, D. C. Paper; 7 x 10 in.; pp. 35, diagrams and half tones. Free until stock is exhausted; 5c. from Superintendent of Documents, Washington, D. C.

THE WASHINGTON CONFERENCE—By Raymond Leslie Bull, Procter Fellow in Politics in Princeton University. New York: D. Appleton & Co., Cloth; 6 x 9 in.; pp. 461. $3.

Devotes 135 pages to Forces in the Background, which are concerned chiefly with Japan; takes up the Conference under The Passing of the Battleship, The Four-Power Treaty, Future Weapons of War, The Defeat of China, and Summaries; closes with the Text of the Treatises, etc., adopted by the Conference.

WATER RESOURCES INDEX INVENTORY FILING SYSTEM FOR RECORDING, COLLATING AND ANALYSING WATER RESOURCES DATA—By J. T. Johnston, C.E., Assistant Director Water Power. Ottawa, Ont.: Dominion Water Power Branch. Paper; 6 x 10 in.; folding maps.

WEAR TESTS OF CONCRETE—By Duff A. Abrams, Professor in Charge of Structural Research Laboratory, Lewis Institute, Chicago, Ill. Reprint from Proceedings American Society for Testing Materials, 1921. Paper; 6 x 9 in.; pp. 24; illustrated.

ZEMENT-KALENDER, 1922—Herausgeber: Dr. Ing. Riepert, Baurat, Charlottenberg, Germany; Zementvertag G. m. b. H. Boards; 4 x 6 in.; pp. 339; line cuts.

Combined diary, directory of German cement industry and manual of cement, concrete and reinforced concrete.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Decries "Band-Wagon" Plea for Licensing

Sir—Your discussion of the licensing question in the issue of July 6 is interesting, timely and good. There are undoubtedly many engineers, as well as some laymen, who favor licensing, in principle, but few seem to carry their arguments or thinking processes to the logical conclusions you reach.

It would almost seem to be self-evident, though it isn't, that licensing is required, if required at all, for the protection of the public, rather than for the protection of engineers, and the difference in this respect between engineers and doctors or lawyers is very well brought out by you. If it is the public which is to be protected, the state, as the protector, must for this purpose specify exactly what degree and kind of skill and ability the licensee possesses, and it should cover not only technical skill but the degree of his business ability and plain horse sense.

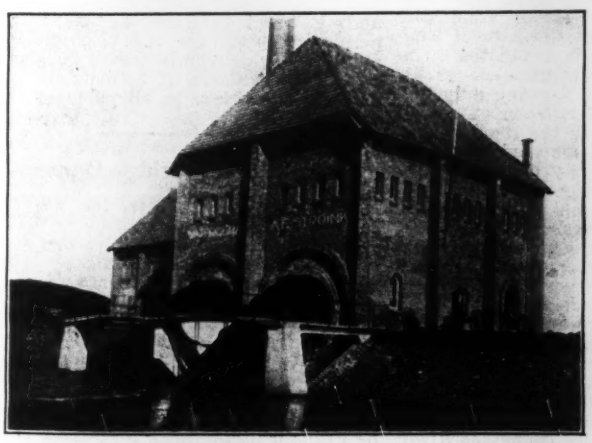
At one of the meetings of the licensing committee of the American Society of Civil Engineers, which I was able to attend, all the speakers, except two, advocated the endorsement of licensing, principally because it had been adopted by several states, because it was, so they assumed, here to stay and therefore, we all ought to get on the band wagon.

I am glad to see that as the leading engineering journal of the United States, you have nerve enough to present the cold naked facts, so that the question can be discussed on its merits and not "get on the band wagon," just because there are some engineers, or even a lot of engineers, who proclaim licensing as the panacea for all the evils, if there are any, or many, of the engineering profession.

New York, July 12. F. LAVIS.

Wood Screw Pumps in Holland

Sir—For the Vollenhove drainage district in Holland there has been recently completed and tested a pumping plant equipped with two steam driven 136-in. screw pumps made after the designs of A. B. Wood of New Orleans, La. The capacity of the pumps was guaranteed at 480 cu.ft. per sec. for 6-ft. lift with an average lift of 2.6 ft. The number of working hours was rather high for Dutch conditions, being figured at an average of 2,000 hours a year while the normal pumping plant for polders in Holland works 800 to 1,400 hours.



HOLLAND DRAINAGE PUMPING STATION EQUIPPED WITH WOOD SCREW PUMP

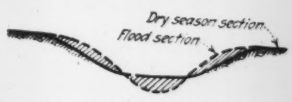
For the given low lift Wood screw pumps gave about 25 per cent better results than centrifugal pumps. It was guaranteed that not more than 2.4 lb. coal per water hp. per hour would be needed. Water is pumped from an area of 110,000 acres, a large part of which is water and morass, so the run-off could be figured at the low figure of 960 cu.ft. per sec. The pumps and machinery were made by Werkspoor at Amsterdam; the plans for the work were prepared by the writer under whose supervision the plant, dikes and improvements were executed. The accompanying picture shows the building from the sea-side

R. VER LOREN VAN THEMAAT,
Nijmegen, The Netherlands, June 28. Civil Engineer.

River Beds Lowered by Floods

Sir—The "fallacy" referred to by your Western Editor on page 819 of the May 18 issue, that an increased height of the levels results in the rise of the river bed has also been entertained here, by not a small number of observers of the biblical rivers Kishon and Namein. These rivers lie south of the Crusade-famed city Acre, and empty directly into the Acre bay.

My close study of these rivers shows that in flood time the actual river beds are considerably lowered. During the dry months (June to October) the mouths of these rivers are practically choked with sea silt. However, there is no record that these rivers have ever gone dry. In flood time the level of the mouth at the sea is about 5 to 7 ft. above the bed.



FLOOD AND DRY-SEASON SECTIONS

It seems to me that the "fallacy" is a result of popular observations of the river banks only. Here as well I have noted that the river banks are somewhat distorted (see sketch), and hence probably the belief that the river beds are higher.

PEREZ W. ETKES,
Haifa, Palestine, Assistant District Engineer,
June 7. Palestine Public Works Dept.

Test of Sewage Sprinkling Nozzles

Sir—We are carrying on a rather exhaustive study of sewage sprinkling nozzles in our hydraulic laboratory and wish to cover the field as completely as possible. The nozzles we have are as follows:

	Name	Shape	Size of Orifice In.
..	Chase	Square	¼
2.	Taylor	Round	¼
3.	Taylor	Square	¼
4.	Worcester	Round	13/16
5.	Worcester	Round	11/16
6.	Merritt	Square	¼
7.	Priestman-Beddoes	Round	¼
8.	Weand "Atlantic"	Round	15/16
9.	Columbus modified	Round	¼
10.	Binks spray	Round	¼
11.	Binks spray	Round	1-1/16

Information as to any additional nozzles which we might secure for test purpose would be appreciated.

Purdue University R. B. WILEY,
Lafayette, Ind. Acting Head, School of Civil Engineering.

Concrete Roads in Manchester 100 Ft. Wide

Two arterial roads have recently been constructed of reinforced concrete in Manchester, England, under the direction of J. B. L. Meek, city engineer. One of these, Princess road, estimated to cost £144,000, is 100 ft. in width and is divided along the center by a strip of land to be laid out as a garden. A second arterial road is now under construction for the same corporation, for which several existing roads have been reconstructed in reinforced concrete with special provision for heavy traffic. In all these works lattice reinforcement was adopted.

NEWS OF THE WEEK

New York, July 20, 1922

Committee Rejects Ford Muscle Shoals Offer

Senator Norris Writes Majority Opinion Severely Condemning Detroit Manufacturer's Proposal

A majority report of the U. S. Senate Committee on Agriculture and Forestry just submitted reports on the various bills referred to it by the Senate in regard to the government-owned property at Muscle Shoals, Ala. After extended hearings the committee decided to reject all of the bids and all of the bills before it. Senator Norris of Nebraska, chairman of the committee, wrote the majority report so far as it is a rejection of the bid and a minority report in so far as it relates to Senate Bill 3420, a bill providing for the government continuation of construction and operation of the plant at Muscle Shoals.

Nine members of the committee signed the Norris report and of these, eight were Republican senators from northern states and one a Democratic senator from Wyoming. Seven members of the committee would not sign the majority report and of these five were Democratic members from the far South and two were Republicans, from Kansas and North Dakota.

FORD OFFER CONDEMNED

The majority report considers thoroughly the history and possibilities of the water power and nitrate development at Muscle Shoals. Because all offers but that of Henry Ford were rejected unanimously there is no discussion of any but his offer and that offer is severely condemned as being unfair to the government and unprecedented in its distribution of the people's property to a corporation.

It states first that the Ford offer is not made as an individual, but as a corporation and that Mr. Ford will be approximately 70 years old before the corporation's control of the property can begin to operate. It recites the various items which go to make up the property and states that in actual salable goods the Ford company would get back a large part of its first payment.

It states further that there is no agreement that the cost of fertilizer shall be reduced one penny, either to the farmer or to anyone else and that after the company had supplied the necessary power to operate Nitrate Plant No. 2, it will have 500,000 to 800,000 hp. to do with as it pleases without government regulation. It calls attention to the hue and cry that would arise if Mr. Rockefeller, say, had made this proposal and states that in spite of Mr. Ford's high reputation, which is acknowledged, that he himself can have no control over the corporation after his death. In effect the proposal would give to a soulless corporation unprecedented rights.

The report condemns severely the so-called amortization payment, whereby the Ford company would pay over to the government annually enough money so that if it were compounded annually at 4 per cent it would pay for the cost of the dam in 100 years. The report points out that the government is not in the money lending business and that instead of amounting to fifty or more million dollars at the end of 100 years as the Ford offer intimates, it would amount only to the actual amount paid in, or about four million dollars. On this basis the Ford company would be getting from the government money at the rate of 2.85 per cent and, as the report notes, it is permitted to make 8 per cent profit on its fertilizer sales, figuring only the actual cost of the fertilizer. The report further condemns the requirement that the government maintain the dam and says that this may be many millions of dollars in the 100 years. It sums these features up as follows: "It means that the government has in effect loaned to this corporation $75,000,000 at 2.85 per cent interest for 100 years and has never received back one-tenth of the principal."

The report devotes a number of pages to a defense of the Norris bill for government management and operation of the work at Muscle Shoals, claiming that this is the only possible way in which the problem of future disposal of the resources of the Tennessee River can be maintained.

St. Louis $74,000,000 Bond Election Date Uncertain

The Board of Aldermen of St. Louis, Mo., adjourned for the summer without passing an ordinance for the $74,000,000 bond issue for public improvements, recommended by a committee of the general council on civic needs after careful study (see *Engineering News-Record*, July 6, 1922, p. 35). The general plan has been approved by the St. Louis Board of Estimate. It is now thought that the bond election will not be held until after the close of this year.

Seek Clarion River Power Permit

The Clarion River Power Co., in care of C. B. Hawley, Munsey Building, Washington, D. C., has applied for a preliminary permit covering the erection of a powerhouse on the Clarion River and the building of a dam to a height of 240 ft. at a point two miles above the mouth of Mill Creek, near Ridgeway, Pa. It is estimated that these works will make available 120,000 hp. of primary power. The plan is to install equipment sufficient to generate 175,000 hp., to be used for public utility purposes.

French Would Have Germans Build Public Works as Reparation

Payment of reparations in the form of public works of vast scope and value has been proposed by Yves le Trocquer, minister of public works of the French government. News dispatches announce that the plan has the approval of the Poincaré government and that it has been referred to the reparations commission.

Although proposals for immediate execution are confined to the establishment of power stations in the Rhone valley for the electrification of railroads in that district, M. Le Trocquer's proposal contemplates the extension of the principle to power development on several other rivers, the reconstruction of the French ports and the construction of new railroads and canals.

The plan is to have French engineers direct the work with Germany supplying the contractors, workers and materials under a stipulation that one-third of the supplies be bought in France. The Rhone River improvements are estimated to cost 3,250,000,000 francs and to require the labor of about 120,000 workers and 10 years' time. A tunnel in the Vosges mountains from St. Laurice to Wesserling would cost 64,000,000 francs and five years' time. Other projects included in the proposal are the Truyere River development to cost 210,000,000 francs, and the Dordogne, 200,000,000 francs.

A. A. E. Joins American Construction Council

The American Association of Engineers at the meeting of its Board of Directors held in Chicago on July 8 accepted the invitation of the American Construction Council to become a member of that body. A. N. Johnson, president of the A. A. E., expressed the opinion that "the American Construction Council will have a most stimulating effect in adjusting the many perplexing problems that confront the public today in the endeavor to carry on the construction of both public and private enterprises in all parts of the country."

Niagara River Bridge Opposed

A bill to incorporate the Buffalo & Fort Erie Public Bridge Co. to build a bridge from Buffalo to Fort Erie was recently defeated in the railway committee of the Canadian Senate. It was represented that the owners of the present bridge, the International Railway Bridge Co., would investigate the possibility of extending their structure so as to accommodate all traffic. Should such extension not be undertaken, it is expected that the proposed charter may be granted at the next session of Parliament.

American Firm To Build Exhibit Building at Rio Exposition

Dwight P. Robinson & Co., New York contractors, who some time ago were awarded the contract for the construction of the building to house the American official exhibit at the Brazilian Centennial Exposition to be held in Rio, beginning Sept. 7, was recently awarded the contract for the construction of the building which will house the commercial exhibit to be put in by American firms or their accredited representatives in Brazil. The building will be constructed of steel and concrete on a site occupying 90,000 sq.ft.

Lets First Brick Road Contract

Contract for construction of the first brick road to be built by the State of Illinois since Governor Len Small's "$30,000 a mile" edict went into effect, was let last month by the Illinois State Highway Department. While smaller political units in the state have been building brick roads, this is the first action of its kind on the part of the state highway department under the present administration.

The Illinois contract, let to J. E. Craine of Murphysboro, Ill., is for 13.32 miles from Cobden to Dongola, Ill. Specifications provide for a base of 10 in. of novaculite or disintegrated chert, laid in two 5-in. courses, a 1½-in. sand cushion, 3-in. vitrified brick and asphalt filler. Curbs of compacted novaculite will be 12 in. wide and 4½ in. deep. The pavement will be 18 ft. wide.

Small Dam Failure Wrecks Large Residence Section

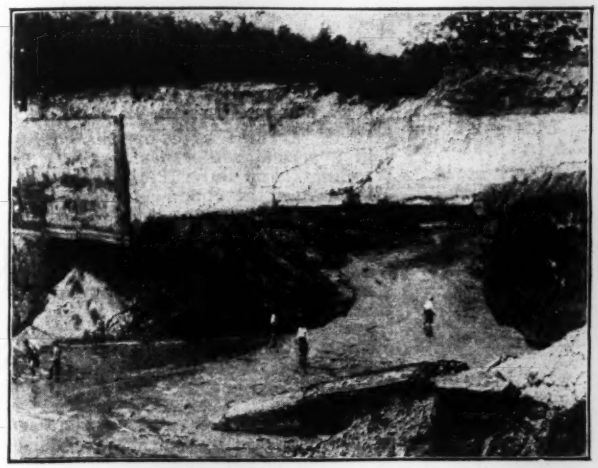
Undermined Concrete Core-Wall to Earth Fill Near Holyoke, Mass., Causes Serious Flood

By C. A. Latimer

Civil Engineer, Holyoke, Mass.

On July 17, at 1:30 a.m. the dam at the west end of Langwald's Pond in Fairview, Mass., failed. The released waters hitting the dam at the lower end of Robert's Pond, approximately a half-mile below, carried that structure out and the combined waters swept on down through Willimansett Brook, into Willimansett, doing what is roughly estimated at $500,000 worth of damage in the Pleasantdale section, without, so far as can be learned, loss of life. The buildings which suffered most were a garage automobile paint shop, laundry and barrel shop which were completely wrecked. Several residences were lifted from their foundations and twisted and a number of outbuildings were carried away. The fact that the Boston & Maine R.R. tracks are carried through Willimansett at this point on an embankment at practically 90 deg. to the path of the flood undoubtedly reduced the loss considerably.

The Langwald's Pond dam, built about twelve years ago at a cost of $65,000 was an earth dam with a plain-concrete core-wall, 30 ft. high, by 300 ft. long, and 15 ft. wide on top. Its upstream slope was 3 to 1; downstream it sloped 2½ to 1 for about 10 ft., then 4½ to 1 for the remaining distance. The soil in this vi-



Langwald's Pond Dam Failure

(Upper Left.) Upper Portion of Concrete Core-Wall Bridged Gap at Point of Undermining

(Upper Right.) Craters Formed by Washout of Earth on Both Sides of Core-Wall

(Lower Left.) Buildings in Pleasantdale Damaged by Water Released by Dam Failure

Floors Fall During Reconstruction of Philadelphia Building

Parts of the tenth and eleventh floors and a wall of an eleven-story building in course of reconstruction in Philadelphia collapsed on July 13, causing the death of two men. The building, located at Broad and Cherry Sts., and known as the Parkway Building, was nearly thirty years old and had originally been the home of a fraternal organization; it was being remodeled for office use. Investigation of the accident is in progress by the Building Inspection Department and by the coroner. Such statements of the owners and of workmen as were obtainable indicate that the inadequate shoring of a wall girder was responsible.

Secretaries Honor Chandler

The secretaries of the A. I. M. E., the A. S. M. E., and the A. I. E. E. tendered a luncheon on July 13 at the Engineers' Club, New York, to Elbert M. Chandler, retiring as acting-secretary of the Am. Soc. C. E., at which they voiced their appreciation of the qualities Mr. Chandler had shown in his contacts with them. Expressions of regret at his leaving were mingled with good wishes for his future.

cinity is sand on clay, and the dam was built of this material. The failure was undoubtedly due to the undermining of the dam and core-wall by leaks or springs, of which several may be seen in the immediate vicinity of the break. The upper section of the core-wall and the spillway are still in place but about 80 ft. of the bottom from 6 ft. to 16 ft. in depth has gone out with the dam.

The Robert's Pond dam had what appears to have been an 18-in. puddle core confined between 2-in. sheathing and is a complete failure. Water marks indicate that this dam was carrying a 5-ft. crest, which, of course, would cause failure of any dam of this type.

The capacity of both ponds was over fifty million gallons of water.

National Societies Urge Use of Employment Service

The four national engineering societies—civil, mechanical, electrical and mining—are engaged in a campaign to increase the usefulness of their free employment service. The societies have issued the following statement regarding the employment bureau, which was organized primarily for members of the parent organizations but which may be used under certain conditions by non-members:

"An employment service for engineers of every variety of training and experience is conducted by the four national engineering societies of the United States. This service brings in touch with the various business men the service of 50,000 trained technical men who are members of these societies and one of the objects of it is to show to the various commercial houses the aid which engineers are rendering to others in the same lines and to help these firms and corporations secure similar assistance. Men of engineering training are prominent in all branches of commercial endeavor and their creative ability is recognized as being of great help in the building up of the Nation's wealth.

"This service is in a position to supply the readers of *Engineering News-Record* and civil engineers, construction superintendents, mechanical engineers, sales engineers, managers and other executives trained in the industry, and is under the direction of W. V. Brown. The office is located in the United Engineering Building, 29 West 39th St., New York City, and is free to both employer and to employee."

Equipment Shipped to Electrify French Midi Railways

Transmission equipment, part of an order amounting in value to more than $1,000,000, has been shipped by the Westinghouse Co. to Bordeaux, France, where it will be transferred to the Midi Railways for use on the electrification of its lines. This road serves the territory in the south of France just north of the Pyrenees. Electrification was begun before the war, using single-phase current at 12,000 volts. Since the war, however, the problem has been restudied and a decision reached to carry through the project on the basis of 1,500 volts direct current. The sections already completed will be changed to make the system uniform throughout.

The Engineer in Public Life

EDWIN K. LARGE

On July 16 Edwin K. Large, a civil engineer, became postmaster of Atlanta, Ga., following approval by the Senate of his nomination by President Harding. Mr. Large is a native of Flemington, N. J., where he was born 41 years ago, but has lived in Atlanta for the past 12 years. After graduation from Princeton University in 1902 with the degree of civil engineer, he began work with the engineering department of the Pennsylvania R.R. as office assistant and instrument man on construction work in Jersey City and Newark. After a brief period on the Pennsylvania's East River tunnels in New York he became main-line assistant supervisor of track maintenance in the Maryland division.

He gave up railway work in 1910 to engage in general development work at Atlanta, Ga., first with the Edgewood Park Realty Co. and later with the Durand Realty Co., of which organization he was vice-president and secretary. During the war Mr. Large served as supervising engineer at Camp Gordon.

"The appointment of Edwin K. Large to the Atlanta postmastership," said a recent editorial in the Atlanta *Constitution*, "will insure for Atlanta the continuance of the post office under honest and highly competent management."

New York Central Wins Suit with City Over West Side Tracks

After litigation begun in 1918 by Mayor Hylan of New York, the Court of Appeals of New York State has unanimously confirmed the title of the New York Central R.R. to its right-of-way along the west side of Manhattan Island between 72nd. St. and Spuyten Duyvil.

The suit grew out of efforts of the preceding city administration to co-operate with the railroad in improving this and adjacent sections of its lines over which is handled the bulk of the freight traffic into the city. The present administration chose to force the improvements by attacking the title of the road to its right-of-way rather than by treaty. The Mayor announces his intention to carry the fight to the U. S. Supreme Court.

Roof of Ancient Mosque in Cairo Collapses

Cable dispatches from Cairo, Egypt, report that the roof of a mosque which has stood for six centuries collapsed on the morning of July 13, at a time when services were just beginning. Some 15 persons were killed.

U. S. Chamber of Commerce Takes Up Fire-Reduction Movement

An active fire-reduction campaign is about to be undertaken by the insurance department of the Chamber of Commerce of the United States as the result of two conferences on the subject, held on June 26 and on July 12. The conference of June 26, called by Governor Ritchie of Maryland, was held at Baltimore, and was attended by several governors, state insurance commissioners and representatives of fire-fighting and credit associations. After a discussion of fire losses and the possibility of reducing them by systematic work, the conference reached the conclusion that some fire-reduction activity should be undertaken at once, that, as it should be national in scope rather than local, the Chamber of Commerce of the United States would be the most logical organization to undertake it. On the basis of this conclusion a second conference was held at Washington on July 12, with the conclusion that the chamber accepted the invitation to direct a fire-reduction campaign.

It was decided at this conference that the various organizations present should appoint one or two representatives each, to form a general co-operating committee for the purpose of conducting the fire-reduction work. The work will be directly in the hands of the insurance department of the Chamber, James L. Madden, manager. A fire-prevention program has already been formulated by the department, to be placed in the hands of local fire-prevention committees, as a means of initiating a general survey on which future effort may be based.

To Sell French State Railways

Carrying out the policy forecast in an earlier issue of *Engineering News-Record*, private ownership of the State Railways of France has been proposed by the new Railway Council, composed of representatives of the five large private railway systems, the government and several public associations. A plan to parcel out the several state lines among the adjacent private systems was rejected by parliament in March. Later, the Minister of Public Works proposed the organization of a company with 66 per cent of the stock held by the government and the remainder by the departments in which the lines are situated, together with the municipalities, local chambers of commerce and a few private individuals. The Council's plan eliminates all state and public participation except that of local chambers of commerce and agriculture. It is stated that experience with government ownership and operation has demonstrated the high cost and unsatisfactory service for such a system.

Concrete Institute to Hold 1923 Meeting in Cincinnati

At a recent meeting of the Board of Direction of the American Concrete Institute decision was reached to hold the 1923 convention in Cincinnati. The date of the convention is Jan. 22-25, inclusive.

Grant Permit to Develop Power at Kettle Falls on Columbia

The Federal Power Commission has authorized the issuance of a preliminary permit for three years to the Washington Water Power Co. for a power project at Kettle Falls on the Columbia River. The ultimate installation is estimated at 153,400 hp. The company proposes to develop the project in three stages correspondingly as a market for the power can be found. In the initial development it is proposed to use the natural fall of about 30 ft. at Kettle Falls. As the demand for power increases, additional capacity will be provided by building a 60-ft. dam across the Columbia River. The height of the dam may later be raised to 75 ft. by the use of gates. Provision is made in the permit for the conveyance to the United States of such lands and rights-of-way as may be required for navigation facilities built by the United States.

Under a treaty with Great Britain made in 1846, the Columbia River is to be kept open for navigation by British subjects trading with the Hudson Bay Co. The permit provides that project works shall be designed to keep existing portages free and open.

English Railways Withdraw Road Transport Bill

Withdrawal of the bill authorizing the London and Northwestern and Midland Rys. of England to engage in highway transport is announced in a report to the Department of Commerce by the commercial attaché at London. Opposition in the House of Commons has been based upon the danger of the railroad companies and other large aggregations of capital competing so severely with smaller transport firms as to drive them out of business.

Hetch Hetchy Tunnel Headings Advanced 4,817 Ft. in May

Although no new records for single heading advances were established in May on the Hetch Hetchy tunnel of the San Francisco water-supply project, the average advance for the month in eleven headings was 437.9 ft., an average of 6.346 ft. per shift.

The detailed figures for each heading are given in the accompanying table. Priest Portal, under sub-contract to Dennis & Wilson, lost three shifts on account of lack of power. The tunnel work as a whole is under contract to the Construction Company of North America.

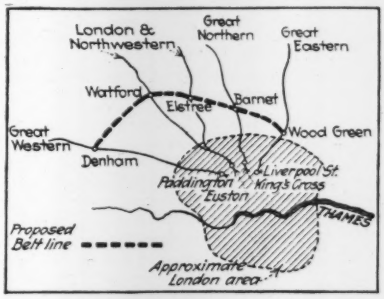
ADVANCE MADE ON TUNNEL HEADINGS IN MAY

Heading	Tunnel Section	Character of Rock	Holes per Round	Superintendent	Shifts Worked	Progress Month of May, Feet	Total Progress to Date Feet
Intake.....	13 ft. 4 in.	Monolithic Granite	48 52	Johnson	62	326	8,819
South Fork E...	13 ft. 4 in.	Monolithic Granite	45 50	Peterson	70	357	9,099
South Fork W..	13 ft. 4 in.	Grandiorite	38	Peterson	74	476	5,082
Adit 5-6 East...	13 ft. 4 in.	Granodiorite	38	Gallagher	62	502	3,576
Adit 5-6 West	13 ft. 4 in.	Quartzite and Diorite	34	Gallagher	93	441	3,636
Adit 8-9 East....	11 ft. 3 in.	Quartzite Schists and Altered Slates	25	Criddle	93	614	2,756
Adit 8-9 West..	11 ft. 3 in.	Schists and Altered Slates	25	Criddle	93	596	2,437
Big Creek East..	11 ft. 3 in.	Altered Slates	25	Fowler	61	419	5,973
Big Creek West.	11 ft. 3 in.	Diorite	25	Fowler	61	405	6,752
Priest.....	11 ft. 3 in.	Altered Slates and Diorite	25	Hickman	90	681	16,691
					759	4,817	64,821

London to Have Belt Railway Connecting Trunk Lines

London Correspondence

A scheme is being formulated for a belt line to link up with the trunk lines of the Great Western, London and North Western, Great Northern and Great Eastern Rys. just outside the congested London area. The line, which will be around twenty miles in length, will make possible direct communication between north and south England without having to pass through the busiest sections.



PROPOSED LONDON BELT LINE

A further advantage is that, in the new grouping scheme, circular suburban services can be operated on the new line without necessitating travel to the terminals and changing from one line to another. On the group which includes the Great Northern, Great Central and Great Eastern Rys., a more equitable distribution of the passenger traffic will be possible. Under present conditions, one terminal of this group, Liverpool Street, is congested while Marylebone (Great Central Ry.) can accommodate more trains. Under the proposed plan, traffic authorities will be able to distribute traffic, according to the capacities of the terminals, between Marylebone (Great Central Ry.), Kings Cross (Great Northern Ry.) and Liverpool Street (Great Central Ry.).

Charge Half Cent to Cross Bridge

It has been announced by the Public Utilities Commission of the District of Columbia that it has authorized the Capital Traction Co., one of the local street-railway companies, to extend its tracks over the new Georgetown bridge across the Potomac River at a cost of $150,000, and to charge an additional fare of one-half cent for each passenger, which extra fare goes to the government for the use of the bridge.

Lumber Men Would Supply Trade Data to Public

Manufacturers Offer Periodical Summaries of Production, Shipments and Stocks

In a letter to the newly-established Trade Associations Division of the Department of Commerce, Wilson Compton, secretary-manager of the National Lumber Manufacturers Association, places its whole statistical organization at the service of the government in such a manner that the public will have all the trade information that the lumber manufacturers compile for themselves as soon as, if not sooner than, it is available for individual member manufacturers.

The purpose of the National Lumber Manufacturers Association in thus making available to the government and public without charge a statistical service that has been built up through many years at great cost is two-fold: (1) To give prompt and conclusive evidence that the subscribers of the association in the collection and dissemination of lumber trade information neither have nor desire any commercial advantages; (2) to pioneer the way for a general exchange of trade association industrial statistics, through the Department of Commerce, so that it may be possible to obtain an accurate current record of the industrial activities of America.

Scope of Statistics

Mr. Compton's letter gives the Department of Commerce exact information concerning the manner in which the National Lumber Manufacturers Association collects and distributes lumber trade information, which consists of weekly statistics of the softwood lumber movements, giving the production, shipments and orders and changes in stocks as reported by eight regional associations, a quarterly graphic lumber summary and a monthly graphic summary of general business statistics.

It is the conviction of the National Lumber Manufacturers Association that if the Department of Commerce chooses to act favorably on its offer to complete statistical co-operation with the government, other great industrial associations will follow suit, with the result that it will be possible to present to the business world periodically an accurate current statistical picture of the commercial movement of the country. It is hoped that such information, wisely diffused, will help to avoid the excesses of industrial activity which are one of the great contributing causes to alternating periodical business depressions.

English Channel Tunnel Again Under Discussion

Discussions of the prospects of building the channel tunnel between France and England have recently been resumed, after they had been suspended for a year or more due to unfavorable governmental attitude. No new financial arrangements have been reported and it is not yet apparent that conditions have changed to make the prospect of the work proceeding any better than heretofore.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal, Que.; Professional Meeting, Winnipeg, Man., Sept. 5-7.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; Annual Convention, New Bedford, Mass., Sept. 12-15.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; Montreal, Que.; Annual Convention, Toronto, Ont., Sept. 14-16.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. St. Petersburg, Fla.; Annual Convention, Cleveland, Ohio, Oct. 2-6.

The Engineers Club of Kansas City at a recent meeting had as its guest of honor Prof. Henry S. Jacoby, former professor of bridge engineering of Cornell University.

The Richmond, Va., Chapter of the American Association of Engineers on July 5 gave a "welcoming dinner" to H. G. Shirley, recently appointed chairman of the Virginia State Highway Commission. Guests included Governor Trinkle, of Virginia; Mayor Ainslie, of Richmond; Eppa Hunton, president of the Richmond Fredericksburg & Potomac R.R., Attorney-General Saunders and officers of the leading civic and professional clubs of Richmond. J. C. Carpenter, president of the Richmond chapter, was toastmaster.

Personal Notes

E. MORGAN BARRADALE, formerly secretary of the New Jersey Interstate Bridge and Tunnel Commission, has been appointed assistant to Clifford M. Holland, chief engineer to the New York and New Jersey commissions which are charged with the construction of the Hudson River vehicle tunnel between New York and Jersey City.

H. L. LEVENTON, former assistant engineer with the California State Highway Commission, has resigned to accept a position with the Western States Power and Electric Co., where he will be engaged on the construction of a large earth dam, with concrete core wall, in Alpine County, Cal.

OTTO FUETTER has been appointed city engineer and street superintendent for the city of Venice, Cal.

J. O. WANZER, formerly with the California State Highway Commission, has been appointed city manager of Marysville, Cal.

JOHN LEONARD VOGEL, formerly designing bridge engineer of the New Jersey Board of Public Utility Commissioners, has been appointed bridge engineer of the New Jersey State Highway Department. Mr. Vogel has had wide experience in bridge and steelwork design and estimating, chief among his positions in the past ten years being assistant bridge engineer for the Central Railroad of New Jersey, principal assistant engineer of the New Jersey Board of Public Utility Commissioners, and designing engineer with Henry Steers, Inc., contracting engineers, New York City.

GEORGE F. NICHOLSON, chief engineer of the Port of Seattle, has returned to this country from Cork, Ireland, where for the last seven months he has been engaged in the study of the port of Cork and its neighbor, Queenstown. Mr. Nicholson submitted a report to the Cork Harbor Commissioners recommending many revisions and improvements in the port facilities.

MAJOR CARY H. BROWN, assistant engineer commissioner of the District of Columbia since March, 1919, will shortly be relieved of that duty and assigned to duty at the engineer school at Camp Humphreys, Va. As assistant engineer commissioner Major Brown has had jurisdiction over the electrical, water and sewer departments and the office of the building inspector of the District.

L. M. WEISIGER, field engineer of the South Carolina State Highway Department, has resigned to accept a position with J. M. Gregory of Newton, N. C. E. D. SLOAN has been appointed to succeed Mr. Weisiger.

H. M. GALLAGHER, formerly chief engineer of the board of port commissioners of the Port of New Orleans, and more recently assistant to the general manager, has resigned to accept the management of the port of Charleston, S. C. TILEY S. MCCHESNEY, the present assistant secretary and treasurer of the board, has been advanced to the post of assistant to the general manager.

Obituary

CAPT. S. B. RICE, one of the oldest officials of the Richmond, Fredericksburg & Potomac R.R., died in Richmond June 27, aged 74 years. He first settled in Virginia when he went there on the construction of the bridge over the James River for the Richmond & Petersburg R.R. in 1865. Lated he was employed by the railroad with which he was associated at the time of his death as engineer of maintenance-of-way.

FRANKLIN D. MACK, for the past twenty-five years consulting engineer for the New York Life Insurance Co., died recently at the age of 58. Previous to his connection with the insurance company Mr. Mack had been in railroad work, having had charge of construction work on the Boston and Westchester R.R. He also had done various other engineering work, including landscape engineering and the installation of refrigerating plants.

W. H. BIGGAR, K. C. vice-president and general counsel of the Grand Trunk Ry. system died in Montreal July 7, aged 69 years. Mr. Biggar, who became general counsel of the system in 1910, was regarded as having the most accurate knowledge of the proceedings connected with the building up of the Grand Trunk system and the Grand Trunk Pacific. He was chief counsel in connection with the recent arbitration proceedings for the valuation of Grand Trunk stock.

J. W. EVANS, former state sanitary engineer and assistant state engineer of Oklahoma, was killed recently at Madill, Okla., when a piece of equipment which was being used in constructing a building, fell while being raised to an upper story. Mr. Evans was formerly with the Oklahoma State Highway Department and previous to that time had done engineering work in the Philippine Islands. He had also taught in the Oklahoma Agricultural and Mechanical College.

Business Notes

THE AMERICAN CONCRETE TIE CORP., of Portsmouth, Va., has been recently been organized and a plant established at Portsmouth, by W. T. Dicky and J. C. Darst for the manufacture of concrete railroad ties. The ties have been used by the Norfolk & Portsmouth Belt Line RR., which has recently placed orders for them.

THE STRAUSS BASCULE BRIDGE CO. announces the completion of its reorganization as follows: J. B. Strauss, president and chief engineer; C. A. Ellis, vice-president and engineer in charge of design; P. L. Kaufman, assistant secretary and contracting engineer, and C. E. Paine, designing engineer. L. O. Hopkins, who had been transferred from the Strauss Bascule Bridge Co. to the Strauss Yielding Barrier Co., has severed relations with both companies.

L. S. GREENWOOD, assistant engineer, Barber Asphalt Co., has been transferred to Boston, Mass. He will be in charge of engineering and sales of built-up roofing, mastic and waterproofing for the New England States.

THE HAMMER-SPRAY CO., New Haven, Conn., consulting and contracting engineers, has recently been formed. The incorporators of the new company are S. A. Hasbrouck, New Haven; C. T. Hull, New Haven; and K. A. Hawley, Canadaigua, N. Y.

F. J. SCHLINK, formerly of the development branch of the engineering department of Western Electric Co., New York City, has been appointed assistant secretary of the American Engineering Standards Committee.

HOLBROOK, WARREN & VAN PRAAG, Decatur, Ill., is the new name of the civil engineering firm formerly known as HOLBROOK, WARREN & ANDREW. Major C. R. Andrew, the retiring member of the firm, is now consulting engineer for the city of Decatur. Alex Van Praag, Jr., the new member of the firm, has been assistant state sanitary engineer for the past two and one-half years. The firm specializes in municipal engineering work.

TERRY, COWAN & SMITH has purchased the machinery sales business formerly known as the Merkle Machinery Co., Kansas City, Mo. The firm will handle complete equipment for water works, electric light and power plants.

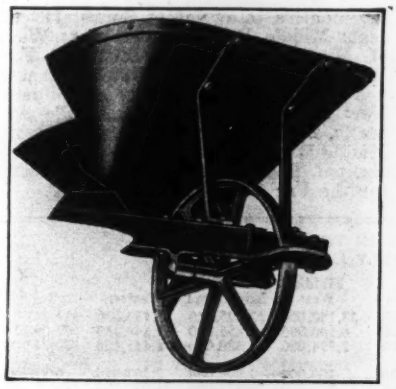
EQUIPMENT AND MATERIALS

Oil Vent Cuts Air Drill Costs

An oil vent designed to prevent oil leakage and lessen the frequency of oiling air drills has been developed by the Chicago Pneumatic Tool Co., New York City. It is applicable to most sizes and types of Little Giant air drills and on new drills is furnished as regular equipment. The vent, as shown in the illustration, contains a top-shaped plunger which automatically prevents all leakage regardless of the operating position of the drill. According to the manufacturer's estimates the saving in time, labor and lubricant effected by this device ranges from $39 to $90 per year, depending on labor costs (40 to 60c. per hour) and time ordinarily consumed (15 to 30 min.) to lubricate drills. Another new air-drill feature is a one-piece interchangeable toggle which permits direct contact of lubricant with crank pins.

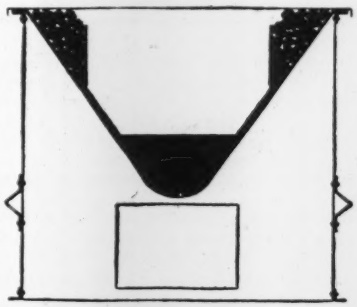
Strengthened Wheelbarrow

An extended nose brace is the new feature which the Akron Barrow Co., of Cleveland, Ohio, has added to its contractors' wood-handle type barrow. As shown in the accompanying illustration, heavy steel braces extend from the frame to the reinforcing plate and thence to the top band, where they are securely bolted, thus reinforcing the entire front end of the barrow.



Continuous Asphalt Roofing Material Kettle

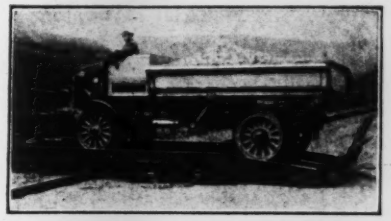
A continuous asphalt-melting kettle for roofing work, with a capacity of 100 gal. and a low fuel consumption, has been put upon the market by the BARBER ASPHALT CO. of Philadelphia. A cross-section of the equipment is shown herewith. The V-shaped tank is cased with sheet metal and the overall dimensions are: Width, 38½ in.; length, 54 in.; height, 36 in. According to the claims of its manufacturers, less than 10 lb. of fuel are required for each 100 lb. of asphalt to be melted.



The continuous feature of the kettle, secured by the arrangement of the side pockets for cold asphalt, where the material is warmed and from which it flows into the bottom of the tank, insures a supply of hot asphalt as long as the fire is kept burning. Cold material never comes in contact with hot material, thus precluding lumps in the bottom of the tank.

Truck Turntable for Road Construction

The Blaw-Knox Co., of Pittsburgh, Pa., has added to its line of construction plant a truck turntable for road building work designed to handle trucks up to 5 tons capacity and with a wheel base of 168 in. The turntable does not take up more than 8 ft. of roadway when the truck is mounting or backing off. The device is mounted upon a skid which protects the finished subgrade from damage.



The turntables are made in three sizes for 2½, 3 and 5-ton trucks, and are operated by one man.

Out-of-the-Ordinary Trade Publications

Drawing Instruments—The C. F. PEASE CO., Chicago, has issued a catalog illustrating and describing its line of American-made drawing instruments.

Steel Wheels—The CARNEGIE STEEL CO., Pittsburgh, has issued revised editions of two booklets describing wrought steel wheels for railway and industrial use. Detailed drawings and specifications for different wheel types and sizes are given.

Dump Wagons—THE WATSON PRODUCTS CORP., Canastota, N. Y., has issued several illustrated pamphlets describing its line of dump wagons, tractors and trailers. Bulletin 11, dealing with the Watson tractor, is published both in English and Spanish. A 4-page leaflet describes the company's train hitch for hauling a string of wagons with a traction engine or road roller.

Metal Coating—THE METALS COATING CO. OF AMERICA, Philadelphia, describes the Schoop metal-coating process in a 17-page illustrated pamphlet just issued. With the company's spraying pistol any of the commercial metals, such as zinc, lead, aluminum, tin, copper, bronze and nickel, are simultaneously melted, atomized and impacted on any surface. Among the uses of the process illustrated in the pamphlet are the following: Structural steel columns coated with zinc after fabrication; coils for superheated steam in chemical apparatus coated with aluminum; 8-in. wrought iron pipe coated with various metals; transmission towers coated with zinc either before or after fabrication; bridge girders coated with zinc, lead or aluminum. An important use of the process is the protection of iron and steel from atmospheric corrosion by the application of zinc coating. In addition to the pistol method of application there are the Gravitas, utilizing metals in the form dust, and the mass coating machine, a new development for spraying in bulk articles weighing from a fraction of an ounce to about 10 lb. Illustrations are shown indicating the resistance of aluminum-coated parts to high temperatures.

Air Compressors — THE DOMESTIC ENGINE & PUMP CO., Shippensburg, Pa., describes in a 12-page illustrated pamphlet several types of its portable gasoline engine driven air compressor. The machines are designed particularly for pumping and hoisting service and for operating rock drills or other pneumatic tools.

Asphalt Heater — LITTLEFORD BROS., Cincinnati, have issued a leaflet describing their Midget No. 69 tar and asphalt heater for road and street maintenance. It is designed to be moved and handled by one man. The capacity of the kettle is 25 gal. The firebox is fitted with renewable cast iron grates and the furnace shell is protected by liners of fire-box steel. The kettle is removable. The equipment is mounted on a pair of 18-in. steel flat-tired wheels.

Dynamite—THE HERCULES POWDER CO., Wilmington, Del., presents the story of the part played by dynamite in the industrial development of this country in a booklet by T. W. Bacchus, vice-president. Among the facilities of modern civilization in the creation of which dynamite has played a part are the railroads, highways, coal and metal mines, improved rivers and harbors, and land cleared of stumps for agricultural purposes.

Integral Waterproofing — The TRUSCON LABORATORIES of Detroit, Mich., have issued in pamphlet form the discussion entitled "Integral Waterproofing of Concrete," which was presented by R. A. Plumb of the Laboratories to the Joint Committee on Concrete and Reinforced Concrete last fall. This discussion is an elaborate investigation of the theory of circulation of water into concrete and a justification of the integral method of waterproofing.

Business Side of Construction

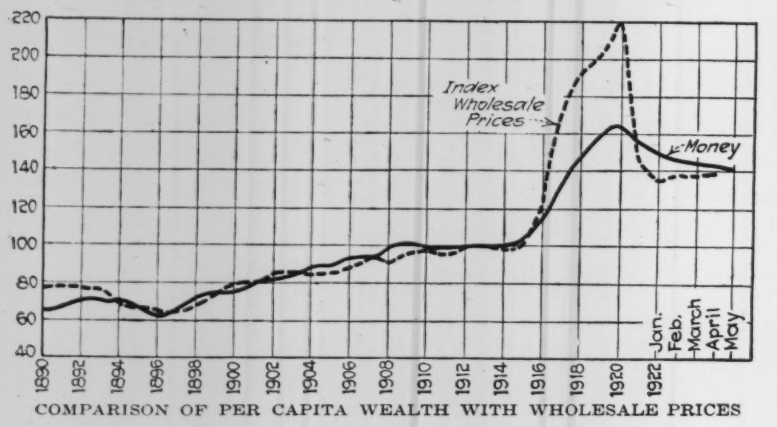
Facts and Events that Affect Cost and Volume

Future Wholesale Prices Will Agree With Money Supply

Is the Opinion of D. L. Bissell, Who Has Studied Relationship Between Prices and Financial Barometers

"In my opinion wholesale prices will in the future agree closely with the per capita circulation," writes D. L. Bissell, C. E., San Diego, Cal., in answer to *Engineering News-Record's* inquiry as to what may be expected of prices. "For the last four years," he continues, "I have made quite a study of the relation between wholesale prices and the money supply. Have also investigated prices in relation to loans and discounts, gold stock, ratio of paper money to gold and in fact about every combination that I could think of that would lead to some concrete result. About the best combination I have been able to make is shown on the chart. From 1890 to 1916 wholesale prices (mean of four standard index numbers) and money agree very well, but due to abnormal conditions brought on by the war do not agree from 1917 to 1920. From 1920 to the present, however, they are agreeing as well as in the years prior to the war.

"If per capita circulation goes down, I believe prices will also recede. As a base 1913 is as good as any other year at present, but I am of the opinion that 1922 would be a good base to use for the future as practically all the inflation and wind will have been taken out of things this year. If things ever do get back to the pre-war basis it will be because the money supply per capita recedes to the same point."



COMPARISON OF PER CAPITA WEALTH WITH WHOLESALE PRICES

Outlook for American Cement in India Promising

Plans for construction operations in India, contingent upon the improvement in the country's finances, are arousing interest in the extent to which American cement may participate. The large stocks of constructional material accumulated during the past three years are exhausted, and engineering firms and importers of cement are inquiring into the availability, quality, and price of materials offered by American, Japanese, and German producers. The cement generally used in India falls into three classes: (1) High-grade British cement, used where special European construction or government specifications name a standard quality; (2) native Indian cement, used only in temporary construction or for purely native enterprises; and (3) a fair quality of cement in which price is the governing factor. British and Japanese, and recently German, manufacturers have competed in supplying the large demand for this latter grade of cement. The extent of the market, however, the great irrigation and hydro-electric projects now in view, and the inevitable revival of building construction in India, warrant a careful consideration of the situation on the part of American manufacturers.

After investigating plans for introducing American cement into India on a competitive basis, it is felt that if advantage is taken of the low cost of Indian manual labor and the low prices of jute sacks, shipments in bulk by steamer lots of American cement can be made at a very low cost, and the cement can be bagged at the port of entry with no loss in quantity and at a total cost sufficiently low to successfully compete in this market. If direct communication with Indian importers and constructional engineers is desired, further information may be obtained from the Far Eastern Division. Refer to report No. 60432.—*Commerce Reports.*

Contracts for First Half of 1922 Exceed Billion

Gain of 34 Per Cent Over Corresponding Period in 1921—Middle Atlantic States Lead

A total of 3,867 important engineering contracts were let in the United States from Jan. 1 to July 1, 1922, valued at $779,766,747 as compared with $581,249,777 for the first half of 1921—a gain of 34 per cent. These figures and the accompanying table were compiled from Construction News, where minimum projects reach $25,000 each on public works, $40,000 on industrial construction and $150,000 in the case of commercial buildings.

If railway contracts ($4,000,000 reported in *Engineering News-Record*) and smaller engineering projects were added to the total given in the table the value of all engineering construction placed in the first six months would probably exceed $1,100,000,000 *exclusive* of residential construction (which exceeds $700,000,000).

The Middle Atlantic section leads with 1,024 contracts valued at $285,457,844 representing 37 per cent of the total value of all large contracts let and includes 52 per cent of the total value of all bridges, 25 per cent of streets and roads, 27 per cent of industrial buildings, 49 per cent of Federal Government contracts and 67 per cent of miscellaneous awards. Other sections of the country stand as follows: New England, 7 per cent of the six month's total value; South, 11 per cent; Middle West, 24 per cent; West of Mississippi, 10 per cent and Far West, 7 per cent. The 3,867 contracts are distributed numerically as follows: New England, 7 per cent; Middle Atlantic, 26 per cent; South, 10 per cent; Middle West, 25 per cent; West of Mississippi, 19 per cent, and 11 per cent for the Far Western states.

VALUE OF CONTRACTS LET IN THE UNITED STATES
JAN. 1 TO JULY 1, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total
Waterworks	$1,019,000	$2,397,844	$1,213,000	$3,190,000	$3,295,000	$3,133,000	$14,247,844
Sewers	232,000	6,898,000	1,693,000	8,580,000	2,055,000	1,640,383	21,098,383
Bridges	369,000	12,056,000	2,421,000	2,794,000	3,888,000	1,415,000	22,943,000
Excavation and dredging	68,000	794,000	747,000	700,000	1,946,000	2,261,000	6,516,000
Streets and roads	5,882,000	44,529,000	38,610,000	41,865,000	26,121,000	21,029,000	178,036,000
Industrial works	14,119,000	24,259,000	15,953,000	23,108,000	5,062,000	5,048,000	87,549,000
Buildings	32,279,000	151,041,000	25,745,000	108,260,000	30,471,000	32,782,000	380,578,000
Federal Government work	261,500	7,665,000	2,619,000	112,000	55,000	4,729,000	15,441,500
Miscellaneous	1,752,000	35,818,000	1,849,000	3,243,810	6,228,410	4,465,000	53,357,020
Total	$55,981,500	$285,457,844	$90,850,800	$191,852,810	$79,121,410	$76,502,383	$779,766,747

Coal and Railroad Strikes Still in Force

The mines have "withheld acceptance" of President Harding's plan to settle the coal strike. The anthracite operators accepted it and a majority of the bituminous operators also have subscribed unconditionally.

The plan proposed: (1) immediate resumption of work under wages and conditions in force Mar. 31: (2) appoint

(Concluded on p. 128)

Building Trade a Good Business Barometer

Construction Operations in Next Two Months Will Indicate Course of Business in General

Morton C. Tuttle, general manager of the Aberthaw Construction Co., Boston, Mass., in giving his views of the present situation in the building trades, says in part:

"It will be interesting to observe the next three months' development in the building trade because the increasing buying by the building trade will stimulate not only the production of building material like steel, lumber, cement, but also will have a tremendous effect upon railroad traffic. It is also worth while to watch developments in the building labor field, because the reactions in the building trade occur with almost laboratory quickness. Movements in the building market probably forecast very accurately the slower but similar movements in manufacturing, giving as accurate a forecast of the future of industrial conditions as can be obtained.

"Following the war there was a building boom, largely caused by the expansion of factories. This boom raised the cost of building until in the middle of 1920 it cost $266,000 to build a factory that would have cost $100,000 in 1915. Following 1920 came the depression, and the price of buildings dropped to 150, compared to the pre-war 100."

It will be noted that Mr. Tuttle calls particular attention to the principal three construction materials of national importance, and to labor, which happen to comprise the four basic factors of the *Engineering News-Record's* Construction Cost Index Number. In November, 1915, the number stood at 101.06 as against $100,000, the actual cost of building a certain factory at that time. By the middle of 1920, costs had advanced to $266,000 for erecting this type of building and this figure is compared with the *News-Record* Cost Index of 265.65 for July, 1920. In the drop from the peak the Index Number fell to 162.04 in March, 1922, at which time building costs in Boston, according to Mr. Tuttle, were 50 per cent above 1913. The present Index Number is 169.70 for July, 1922, showing a rise of over 7 per cent during the last four months.

Cement Production in June Gains 1,949,000 Bbl. Over Year Ago

Cement production figures for June, released last week by the Geological Survey, show an increase of 1,949,000 bbl. over June, 1921, while shipments were 2,893,000 bbl. heavier. Stocks are 2,225,000 bbl. lower than at the end of May and 482,000 bbl. under the reserve on hand one year ago.

Bond Prices During June Irregular

Sales of municipal bonds in June showed a slight falling off from the May record, but a considerably stronger demand has been the feature of the market throughout the week just past. Bond prices, generally, showed marked irregularity until the first week in July.

Among the more important new issues were the Chicago Sanitary District, $5,000,000 4s yielding 4@4.30 per cent; Cleveland $2,000,000 4½s yielding 4@4.35 per cent, and Nassau County, N. Y., $1,500,000 4½s (road improvement) at 102.319, a basis of about 4.10 per cent.

Of the forty-three representative issues shown in the accompanying table, one sold at par, thirty-nine above and three below par; the yields ranging from 3.98 to 5.93 per cent. The rates varied from 4 to 6 per cent. All those drawing 6 per cent were in the Southern and Western states; the 5s and 5½s in the Middle West and west of the Mississippi; the 4½s and 4¼s in New England and the Middle Atlantic states and both 4s in Maine.

The number of municipalities issuing permanent bonds and the number of separate issues during June were 521 and 703 respectively, according to the *Commercial and Financial Chronicle*. This contrasts with 600 and 805 for May and 366 and 520 for June, 1921.

REPRESENTATIVE BOND SALES OF JUNE AND JULY, 1922

State	Purpose	Amount	Maturity	Rate Per Cent	Basis	Sold For	Dated	Purchased By
Maine	Highway	$650,000	1943–52	4	3.98	100.403	July 1, 1922	S. W. Straus & Co., New York.
	Bridge	.....	.....	..	.....	.....	.....	.....
County								
Allegany, N. Y.	Highway	$250,000	1932–36	4½	4.15	103.26	Mar. 1, 1922	Barr Bros. & Co., New York.
Bay, Mich.	Highway improvement	76,700	.....	5	.....	100.388 100.396	June 1, 1922	Northern Title & Trust Co., Bay City.
Broward, Fla.	Highway	400,000	1932–46	6	5.81	102.115	Jan. 1, 1922	A. T. Bell & Co., Toledo.
	Navigation port	100,000	.....	..	.....	102.135	.....	.....
Cumberland, Me.	Courthouse	160,000	1942	4	4.13	98.237	July 1, 1922	Fidelity Trust Co., Portland.
	Bridge	100,000	.....	..	.....	.....	.....	.....
Dubois, Ind.	Roads	10,500	1932	5	.....	102.314	June 15, 1922	John H. Krodel Geo. L. Drexler } Jasper, Ind.
		8,300	.....	..	.....	102.571	.....	
Essex, Mass.	Bridge	56,000	1923–32	4½	4.17	100.37	July 1, 1922	Merrill, Oldham & Co., Boston.
Hamilton, Ia.	Drainage	60,900	1926–32	5½	.....	100.56	May 1, 1922	White-Phillips Co., Davenport.
Harris Co., Drainage Dist., Tex.	Ditch	56,000	.....	6	.....	92	.....	.....
Kosciusko, Ind.	Highway improvement	18,700	1923–32	5	4.55	102.197	May 15, 1922	A. P. Flynn, Warsaw.
Morgan, Ind.	Highway improvement	14,000	1923–32	5	4.69	101.51	July 1, 1922	Thos. D. Sheerin & Co., Indianapolis.
Polk, Minn.	Road improvement	150,000	.....	4½	.....	100.13	.....	Minnesota Loan & Trust Co., Minneapolis.
Pulaski, Ind.	Highway	54,000	1923–32	5	4.59	102	June 15, 1922	J. F. Wild & Co., Indianapolis.
Seminole, Fla.	City improvement	100,000	1952	6	5.40	101.131	July 1, 1922	Marx & Co., Birmingham.
Smith, Tex.	Road	360,000	1952	5½	.....	100.31	.....	Weil, Roth & Co., Cincinnati.
Trinidad Paving Dist. No. 13, Col.	Paving	110,000	.....	6	.....	100	.....	.....
Trumbull, Ohio	Road	104,900	1923–31	5½	4.91	102.629	July 1, 1922	Hayden, Miller & Co., Warren.
Municipality								
Amity, Ore.	Water supply	$8,000	1942	6	.....	102	July 1, 1922	V. R. Dennis Constr. Co., Amity.
Bellevue, Ohio	Street improvement	9,200	1924–38	5½	5.47	100.04	June 1, 1922	Friedley and Mench, Bellevue.
Bellefontaine, Ohio	City improvement	137,000	1923–38	5½	5.07	102.50	Mar. 1, 1922	Seasongood and Mayer, Bellefontaine.
Bristol, R. I.	Highway	110,000	1923–42	4½	4.47	100.219	July 1, 1922	Merrill, Oldham & Co., Boston.
Cadiz, Ohio	Paving	15,000	1924–31	5	4.99	100.067	June 1, 1922	First National Bank of Cadiz.
Central Falls, R. I.	Highway	100,000	1923–32	4½	4.44	100.79	July 1, 1922	Harris, Forbes & Co., Boston.
	Sewer	125,000	1938–52					
	Water	150,000	1933–52					
Deposit, N. Y.	Highway improvement	20,000	1923–42	5	.....	100.50	July 1, 1922	Sold locally.
Durham, N. C.	Street improvement	300,000	1924–42	5	.....	100.65	July 1, 1922	A. B. Leach & Co., New York and others.
	Water	150,000	1925–62					
Estelline, S. D.	Light	16,000	.....	6	.....	100.25	June 1, 1922	Gates, White & Co., St. Paul.
Freeport, N. Y.	Light	150,000	1927–51	4½	4.30	102.422	July 1, 1922	Farson, Son & Co., New York.
Glendale, Col.	City improvement	23,000	1926–48	5½	5.49	100.049	June 1, 1922	Wm. R. Staats Co., Glendale.
Great Barrington, Mass.	Pavement	40,000	1923–32	4½	4.14	100.516	July 1, 1922	B. J. Van Ingen & Co., Boston.
Greensboro, N. C.	School	300,000	1924–51	5	4.92	100.78	July 1, 1922	Clairborne, Royall & Co., Goldsboro
	Water and sewer	275,000	1925–62					
	Street improvement	400,000	1923–32					
Kernersville, N. C.	Water	105,000	1924–62	6	5.93	101.	July 1, 1922	Prudden & Co., Toledo.
	Sewer							
Lima, Ohio	Paving	97,200	1923–31	5½	5.02	102.37	May 1, 1922	Guardian Savings & Trust Co., Cleveland.
Lorain, Ohio	Paving	101,807	1923–31	5½	4.92	102.569	May 15, 1922	Title Guarantee & Trust Co., Cincinnati.
Monrovia, Cal.	Park	40,000	1923–62	5	4.766	102.75	June 1, 1922	Citizens National Bank of Los Angeles.
Morgantown, N. C.	Water	250,000	1925–62	6	.....	104.04	July 1, 1922	Provident Savings Bank & Trust Co., Cincinnati.
New Britain, Conn.	School	570,000	1925–52	4½	4.51	100.715	Feb. 1, 1922	Estabrook & Co., Boston.
	Park	100,000	1924–43	5	4.51	100.75	.....	Watkins & Co., Boston and others.
Oxford, Ohio	Waterworks	56,000	1923–46	5½	5.03	104.17	June 1, 1922	Title Guarantee & Trust Co., Cincinnati.
Penn Yan, N. Y.	Street improvement	27,500	1923–33	5	4.66	101.81	July 1, 1922	Union National Corp., Penn Yan.
Seaside Park, N. J.	Water supply	70,000	1924–62	6	5.99	100.178	.....	Outwater and Wells, Jersey City.
Texarkana, Tex.	Paving	200,000	1928–42	5	.....	97.85	June 1, 1922	Wm. R. Compton Co., St. Louis and others.
Tonawanda, N. Y.	Street improvement	88,000	1933	4½	4.30	101.74	July 1, 1922	First Trust Co., Tonawanda.
Vero, Fla.	Public utility	68,000	1940–49	6	5.89	101.47	Mar. 1, 1920	G. B. Sawyers Co., Jacksonville.
Wilson, N. Y.	Water	58,000	1926–62	5	.....	106.077	June 22, 1922	Riverhead Savings Bank, Wilson.
	Sewer	56,000	1924–52	5	.....	105.857		

Coal and Railroad Strikes

(*Concluded from p. 126*)

ment of a commission of eleven, of whom three would be named by the miners, three by the operators, and five by the President; which should (a) fix by Aug. 10 wages and working conditions to hold until Mar. 1, 1923; and (b) institute an exhaustive investigation looking to the complete reorganization of the industry.

The miners' stand was that (1) they were unwilling to consent to any revision of wages and working conditions until the conclusion of the reorganization commission's work, and (2) they wished acceptance of the plan to include all mines affected by the strike, including those in non-union fields.

* * * * *

Although peace talk is rife no definite information is available as to a settlement of the shopmen's strike. At a conference between the union leaders and the managers called by the Labor Board on July 14, the former laid down four questions for discussion. (1) farming out shop work by contract. (2) Labor Board decision as to certain rules; (3) as to wages; and (4) establishment of adjustment boards. They demanded also the restoration of strikers without impairment of seniority. The carriers offered to meet their stand on (1) and (2); but urged that (2) and (3) be settled by rehearing before the Labor Board. They refused to agree to the stipulation as to the seniority and the union leaders insisted on a settlement of (2) and (3) before calling off the strike.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of July 6; the next, on August 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$2.68	$3.65	$4.00	$2.68	$2.86	$3.60	$3.10	+$3.75	$3.75
Structural rivets, 100 lb.	3.60	4.35	5.50	3.10	3.90	4.45	4.25	3.75	6.50
Reinforcing bars, ¾ in. up, 100 lb.	2.58	3.50	3.50	2.58	2.76	3.67½	2.55	3.60	2.90
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9–5%	—46%	49.1%	53%	30.00
Cast-iron pipe, 6 in. and over, ton	50.80	49.00	51.50	46.60	50.50	57.00	51.00	53.00	50.00
Concreting Material:									
Cement without bags, bbl	2.40@2.50	2.50	2.25	2.05	2.29	2.90	+2.71	2.90	+2.78
Gravel, ¾ in., cu.yd.	1.75	1.85	2.25	1.80	1.50	1.75	2.25	1.10	1.50
Sand, cu.yd.	1.00	1.15	2.25	1.80	1.00	0.75	1.50	1.10	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	49.00	39.00	39.00	49.00	—40.00	+51.00	31.00	22.50	47.00
Lime, finishing, hydrated, ton	15.80@16.17	23.00	25.00	18.00	29.00	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	2.75@3.14½	1.80	2.50	1.40	1.40	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	11.00	11.15	11.00	—16@17	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, per block	Not used	+.0758	.115	.0707	.086	.08	....	.11	.09
Hollow partition tile 4x12x12, per block	.1112	+.0758	.115	.0657	....	.08	.108	.11	.08
Linseed oil, raw, 5 bbl. lots, gal.	.93	—.98	1.07	+1.01	1.03	+1.16	..04	.86	1.04
Common Labor:									
Common labor, union, hour	.60	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.44@.60	.20	.25	.72½	.35@.50	.35@.50	.47½@.50	.... +.25@.30	

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81¼c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed store quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at pit.

Montreal quotes on Douglas fir instead of pine. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.10 cents. Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $30; 6-in., $110.

Changes Since Last Week

Structural steel quoted in Seattle warehouses at $3.75 as against $3.60 per 100 lb.; mill shipments, $3.25 by both rail and water, taking from six to eight months for deliveries from Eastern producing centers. Steel stocks are low in Seattle warehouses with demand increasing. Uncertainty in the fuel situation is causing growing firmness in the Pittsburgh mill price. Shapes and bars quoted at a minimum of $1.70 on current business; $1.80 on small tonnages with deliveries uncertain. Price of $1.60 per 100 lb., however, still existent on contracts, for large tonnages, already made with regular trade.

Cement quoted in San Francisco at $2.71 as against $2.63 and in Montreal at $2.78 as compared with $2.46 per bbl. last week. Duluth quotes $2.04, advanced from $2.02. No price changes elsewhere despite advancing fuel costs.

Douglas fir quoted in Minneapolis at $40 as against $41 per M ft. b.m. Although demand for structural timbers has continued exceptionally active during the last week, no changes in price are noted at the principal cities.

Common brick down $1 per M in Minneapolis; hollow wall tile advanced slightly in Atlanta.

Linseed oil up 3c. in Chicago; 4c. in Denver and down 2c. per gal., 5 bbl. lots, in Atlanta. Flax seed market firmer and paint trade active.

Common labor rates in Montreal quoted at 25c.@30c. per hr. as against 20c.@30c. per hr. last week. Demand for building labor affecting rates in other cities. Plasterers are in greatest demand in New York; other building trades mechanics scarce. Cement and concrete laborers, however, greatly in excess of demand.